INDUSTRIAL ARTS
FOR
SECONDARY SCHOOLS

BULLETIN 331

LESTER K. ADE
Superintendent of Public Instruction

COMMONWEALTH OF PENNSYLVANIA
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FOREWORD

This bulletin is the result of the thinking of many persons. At the Christmas meeting of the P.S.E.A., 1936, a committee of leaders in industrial arts in Pennsylvania was appointed to establish policies which might serve as tentative State standards, tentative, because in a changing society, curriculums should not be planned with permanency.

It contains much pertinent material that will help solve the problem of providing answers to the question, "What shall we teach the seventeen- and eighteen-year old student?"

Four major divisions were planned and completed: I. Philosophy; II. Content and Method; III. Supervision; and IV. Floor Plans and Equipment.

Charles F. Bauder, Director of Industrial Arts, Philadelphia Public Schools; S. L. Coover, Director of Industrial Arts Education, State Teachers College, California; John F. Friese, Associate Professor of Industrial Education, Pennsylvania State College, State College; and E. E. Howard, Director of Industrial Arts Education, State Teachers College, Millersville, agreed to prepare these sections respectively.

Professor Coover assisted by his staff, especially R. Lee Hornbake, wrote the section on Content and Method. Professor Friese enlisted the aid of many schoolmen throughout the State. The work of these persons—forty-eight in number—is gratefully acknowledged. By no means all the material obtained could be used in this bulletin, especially that referring to the curriculum, covered in Section II. Professor Howard and his staff were responsible for Section IV on Floor Plans and Equipment.

"Acknowledgment is given to those committees of industrial arts teachers who furnished valuable suggestions with respect to industrial arts equipment in connection with 1938 Schoolmen's Week at the University of Pennsylvania."

We acknowledge the courtesy of Acting Superintendent Louis Nusbaum of the School District of Philadelphia, Dean Marion R. Trabue of Pennsylvania State College, President Robert M. Steele of the State Teachers College at California, and President Landis Tanger of the State Teachers College at Millersville, in making it possible for the members of their staffs to assist us.

Acknowledgment is made to Elroy W. Bollinger, New York State Department of Education, for material prepared at Ohio State University adapted for use in Section IV.

Lane C. Ash, Adviser, Industrial Education in the Department of Public Instruction, and W. E. Brunton, Area Coordinator, Industrial Education, University of Pennsylvania, Philadelphia, helped faithfully with the task.

The bulletin was written under the direction of Dr. Walter B. Jones, Chief of Industrial Education, and Dr. Paul L. Cressman, Director of the Bureau of Instruction.

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CONTENTS

Industrial Arts for Secondary Schools

I. THE PLACE OF INDUSTRIAL ARTS IN MODERN EDUCATION

The primary function of the public schools is to develop an enlightened citizenry for service in a great democracy. Among important responsibilities of citizenship is that of participation in the work of the community. Every good citizen is a worker and a producer in whatever line. He is also a consumer affected by the intricate interdependence of all occupations and requiring a background of knowledge for the wise choice of purchased articles. He is a voter, whose knowledge of affairs, including the contributions and the problems of industry assists to proper discrimination at the ballot box. Industrial arts as an area of learning, parallel with other subjects and curriculums and correlated with them, contributes to the realization of the goal of enlightened citizenship.

This is essentially an industrial age; modern civilization is dependent largely upon science, invention, and skill. The manufacturing and construction industries are important among the activities that make for the material well-being of the people. They should be exemplified in the facilities provided by public education. The general education of every public school pupil is incomplete without concepts, understandings, and appreciations regarding industry and its hosts of workers. Industrial arts as an educational field makes this desired contribution to the pupil's development. It concerns itself with the esthetic and economic values of materials, with basic processes of manufacture and construction, and with many problems of workers.

The public schools, through the grades, should be rich in provision for pupils' experiences (1) that teach the necessity and dignity of work; (2) that illustrate the diversification of industry; (3) that provide for testing personal interests and aptitudes in representative crafts; (4) that serve avocational interest in construction; (5) that develop skills in making minor repairs around the home; and (6) that develop consumer knowledges and appreciations. These six points are served by industrial arts as a phase of the general education desirable for all.

Certain pupils in upper grades of the schools will desire occupational preparation for entrance to employment as industrial workers. Other persons, already engaged in industry, will want to improve their proficiency. The service of the schools to these groups is regarded, not as industrial arts education, but as vocational industrial education. Industrial arts merges into industrial or trade education at the time when the student's objectives change from the general to the specific.

A. THE GENERAL VALUE OF INDUSTRIAL ARTS

Industrial arts is a phase of general education that concerns itself with the materials, processes, and products of manufacture and construction, and with the contribution of those engaged in industry. The learnings come through the pupil's experiences with tools and materials and through his study of resultant conditions of life.

Industrial arts is a curriculum area rather than a subject or course. It has general values that apply to all levels; in a continuous program these values are progressively intensive, and are cumulative in their effect, as the pupil advances in maturity.

Through such a program:

1. The Pupil Gains Knowledge:
   a. Of the changes made in raw materials to meet the needs of society
   b. Of tools and industrial processes
   c. Of the constant adaptation of materials, tools, and processes to meet changing needs and conditions
   d. Of industrial workers and working conditions
   e. Of factors governing production and cost

2. The Pupil Grows in Appreciation:
   a. Of the value of information regarding occupations, as a background for a wise choice of a career
   b. Of the importance in modern life of tools and industrial processes
   c. Of the artistry of the designer and the skill of the artisan
   d. Of the dignity of productive labor

3. The Pupil Grows in Ability:
   a. To plan constructive projects
   b. To select and use sources of industrial and related information
   c. To handle tools and materials
   d. To express with material things his individual interests
   e. To use effectively his recreational time
   f. To work and share as a member of a group
   g. To evaluate work and its products
   h. To make minor repairs about the home

4. The Pupil Develops Attitudes:
   a. Of concern for safety practices
   b. Of consideration for workers in all fields
   c. Of regard for cooperation among the members of a group
   d. Of respect for property

5. The Pupil's Daily Living is Enriched:

   a. By an increasing mastery of manipulative processes
   b. By a growing self-respect as a result of successful participation in work with tools and materials
   c. Through pleasurable experiences in self-expression

B. THE VARIOUS LEVELS OF INDUSTRIAL ARTS

1. Elementary Schools, Grades I to VI

The elementary schools constitute the period of foundational education, of education in the common subjects, and of beginnings of concepts of industrial processes and interdependence of consumer and producer. Industrial arts in these grades provides activities and experiences for the child of either sex that will help him:

a. To satisfy his desire to construct and build
b. To understand what is going on about him in the industrial world
c. To become acquainted with the modes of living and the arts and crafts in past civilizations
d. To come to some realization of the interdependence of peoples and the necessity for cooperation
e. To acquire some background for evaluating products of industry

2. The Secondary School

a. *Junior High Schools*

The term "junior high school" refers here to a program of education especially adapted to the problems of boys and girls during their early adolescent years. This period is one of exploration and guidance preliminary to choice of occupational preparation. Industrial arts, as a part of general education, in these years:

(1) Provides information regarding industry and workers
(2) Reveals employment opportunities offered by industry
(3) Satisfies the boy's and girl's desire to create useful things
(4) Develops hobby and handy-man interests and abilities
(5) Contributes to improving the tastes and judgment of the prospective consumer
(6) Develops interest and ability in home repairs and maintenance
(7) Affords practice in safety related to the school, home, and industry
(8) Gives opportunity for cooperative effort in groups
(9) Develops respect and personal responsibility for property and its care

(10) Provides a testing program for determining aptitudes in manual activities

b. *Senior High Schools*

Senior high schools provide a period of advancement toward a chosen goal, as well as offering youth an opportunity of understanding problems which confront youth as youth. Industrial arts as a part of general education contribute to these ends by:

(1) Developing an appreciation of design and quality in manufactured products
(2) Providing practice in the use of materials and tools for recreation and home utilization
(3) Sampling a variety of industries, through advanced school courses, in preparation for entrance as a beginner into (i) the skilled trades or (ii) into collegiate study of engineering, architecture or other professions involving manipulative processes
(4) Providing a background for future education for professional work in teaching in the industrial arts field, or for avocational service as Scout Executive or Camp Director

For those pupils in senior high schools who desire definite trade preparation for admission into the skilled trades with advanced apprentice standing, industrial arts of general values gives way to vocational industrial education with specific trade preparation objectives, or vocational schools of separate organization may be provided.

3. Extension Schools and Out-of-School Activities for Adults

Because the fundamental justification for public education lies in the development of an enlightened citizenry, the responsibility of the public schools extends indefinitely into the adult field. Extension schools provide for the continued development of every person, of whatever age, who desires and can profit from further education.

Industrial arts contributes to all of the objectives of adults who seek the service of extension schools for general education; namely:

a. Extension of formal education
b. Americanization
c. Association with others in improvement of community conditions
d. Conservation of health
e. Companionship with persons of similar interests
f. Development of recreational interests
g. Personal guidance, exploration of occupations, or personality adjustment to industrial conditions

Some adults attend evening and part-time schools for the particular purpose of improvement within the present industrial occupation. It is not industrial arts, for general values, which they need, so much as specific vocational extension instruction in technology or craft practice. Likewise, other persons of industrial experience unemployed or dissatisfied with the present vocation desire the aid of extension schools for preparation sufficient to gain a foothold in a new or related occupation. Trade preparatory courses may be offered for them in free-time classes, provided only that the new vocation be such that short-time preparatory courses would be truly functional. These adults, like those of the vocational extension group, do not need industrial arts but, rather, specific trade preparation.

II. CONTENT AND METHOD

A. THE PROBLEM

A generation ago it would have been a rather simple task to outline in detail the content and method of industrial arts or either one of its "historical ancestors"—manual preparation and manual arts. First of all content and method could have been treated separately, content representing something to be taught, and method indicating the way to "put that something across." One would have considered his job completed upon analyzing one industrial area—perhaps woodworking—and this primarily from a vocational or quasi-vocational viewpoint.

Today the problem is fortunately more difficult for many reasons. For example, industry has become a major influence in daily living, hence, industrial arts has more numerous and more comprehensive functions to perform in interpreting this complex society to young Americans. These functions cannot be met successfully by having boys and girls make a few projects in wood and several "plates" in drawing.

The content of industrial arts expands almost daily with new inventions and discoveries, new materials and products, and new problems arising from the affects industry has upon society. No breakdown of content could possibly be complete, and even if it were subsequently so the problem would be solved only in part. A list of teaching materials still leaves one with the task of using the materials for worthwhile purposes. The focal point of teaching lies in the learner rather than in materials of instruction. In brief, industrial arts content represents a *means* to an *end* rather than an *end* in itself.

Except for purposes of discussion, method cannot be separated from content since *what* one teaches and *the way* one teaches are mutally interdependent. Two items thus involved usually lead to difficulty in explanation.

Despite these complications much can be done in the way of pointing out content possibilities and of suggesting how such materials may be used. These problems fall within the scope of this section of the bulletin.

1. What is the Nature of Industrial Arts?

Many persons are familiar with industrial arts through manual preparation and manual arts programs. A word of distinction is offered. Manual preparation was one of the earliest forms of organized handwork in the schools of America. It was Russian in origin and may be characterized as work primarily vocational in nature with instruction in the form of *practice exercises* based upon *trade* and *occupational analyses*. Manual arts was Finnish and Swedish in origin and found acceptance in American schools after 1894. The parent movement of manual arts (hŭs Sloyd) was first projected for its general education

values and embraced many useful forms of handcraft, but was later reduced to the making of models in wood and to furniture-making, and in some instances to mere whittling. The primary methods of manual arts teaching were imitation and repetition.

Industrial arts is a movement more nearly indigenous to America. It retains the *manipulative* aspects of the aforementioned predecessors but has added many other forms of activity such as experimenting, investigating, reading, and visiting. Industrial arts implies other basic changes as well. General education rather than vocational education values or purposes are served. The chief concern lies in the *learner* and his *growth* rather than in objects made. Concrete social values are emphasized. The source of content is *all* the basic industries and other *workers* and *problems* as well as industrial *processes* and *products*. Industrial arts is considered an integral part of a modern secondary school program not only because of the psychological soundness of *manipulative* activity and the use of material things, but also for the *unique experiences* and *points of view* which industrial arts offers the learner in many typical human activities.

2. For whom is industrial arts intended?

Industrial arts is considered a subject area of significance for all boys and girls. As an *area* it is much more inclusive than specific subjects such as wood-working or mechanical drawing, just as social studies implies more than civics, history, sociology, and the like. Industrial arts "has come to mean a broad program—the organization of economic, social, scientific, materialistic and idealistic knowledge, as such is related to the lives of people in an industrial age." [1]

There are examples of excellent industrial arts programs in kindergartens and elementary schools, as well as in secondary, collegiate, and adult education programs. The treatment in this monograph is confined to the secondary school viewpoint, but much that is said should have broader applications.

It has been assumed on some occasions that persons who exhibit slow-learning characteristics in other school subjects will be very successful in industrial arts. This is likely due to a common belief that everyone has some one "long suit"—something in which he is especially good, and that if this "long suit" is not in an "academic" subject it is certain to lie in the "manipulative" field. However, science demonstrates a *general consistency* of ability in many fields of work. There is a tendency to place a large amount of belief in aptitudes, but the science in the field has not defined the true nature of these aptitudes. That there are such aptitudes is not questioned, but the information now available does not warrant sweeping generalizations regarding what they are, and what may be done with them.

[1] United States Department of the Interior. *Industrial Arts: Its Interpretation in American Schools*, p. 64 (Bulletin No. 34, 1937).

Industrial arts is of special importance to the rapid learning and socially normal pupil. A study of an individual rarely, if ever, reveals a need for all "academic" or all "manipulative" experiences. The rapid learning and socially normal person will profit most from good industrial arts programs just as he does from any other group of functional experiences. It will be this type of person who can be expected to make significant contributions toward the solution of social-economic problems, and will develop many of the new processes and products of industry.

Secondary school industrial arts programs do not require that pupils be proficiently skilled in order to qualify for industrial arts work. Enriched industrial arts programs provide for a variety of types of activity. Since the end of industrial arts is not direct occupational preparation, standards of skill development are stated in terms of the individual pupil's capacities.

Inasmuch as all boys and girls in secondary schools are to live in a democratic society with a predominantly industrial economy, industrial arts has potential values for the entire school population.

3. Why enriched industrial arts programs?

The problem of content and method is complicated further by the demand for enriched industrial arts programs. The sources of these demands lie within and outside the school. Several of these factors are discussed below.

a. *Influence of Industry on Daily Living.* The America of today is highly industrialized; industry affects everyone economically, socially, morally, and politically. From an economic viewpoint one is either employed by industry or his means for earning a living is sensitive to the tempo of industry. One's social status depends largely upon his employment and this, as stated, reverts to industry. The nation's morals are continuously modified by social intercourse which is facilitated by such industrial products as the radio, automobile, airplane, and motion pictures. Political problems—wage and hour legislation, unemployment, social security—in fact, practically all legislative programs are prompted by industrial conditions. Difficulties arising from urbanization, highly specialized employment, occupational shifts, and an increased amount of forced-leisure time are typical of a machine age. One could not be expected to live intelligently in an industrial society unless he had some understanding of these and other influences. Enriched industrial arts programs provide these understandings through offering the pupil experiences of a *participating* and *active nature* in the study of the materials, processes, products, and problems of industry and their influences upon society.

Industry is the source of many problems which confront youth. A generation or two ago children participated from an early age in

supplying their needs and wants of food, clothing, and recreation. One knew very early whether or not he could earn a living since the farm and worthwhile occupations provided him with the opportunity to try his hand at "man's work." Today a person is likely to be an adult before he is employed. In 1930 only 4.7 per cent of the population of the ages fifteen years and under was gainfully employed.[2] One third of the unemployed are between sixteen and twenty-four years of age.[3] The advancing employable age and the lack of opportunity for employment cause many youth to question their likelihood of success and recognition. This uncertainty makes for serious mental disturbances and, in some cases, results in delinquency. Enriched industrial arts programs offer many of these persons an opportunity to work in representative industries and thereby derive some feeling of security. In some instances these industrial arts experiences result in the development of earning abilities.

Forced idleness causes youth to seek things to do to occupy their time. They are harassed in this attempt not only by the fact that outlets formerly available such as the farm, shop, field, stream, are no longer accessible but also that much commercialized recreation in addition to being costly makes for *passive* rather than *active* participation. Passive participation does not give one a *sense of achievement.* A demand for a creative type of activity is evidenced in the community theatre, forum, community orchestras, and arts and crafts movements. Much of this has occurred without the direction or cooperation of the school. Enriched industrial arts programs are very effective in developing those interests and abilities that make for satisfying experiences in hobbies of *arts* and *crafts,* in hobbies related to the material cultures of various people, and in hobbies associated with the *problems* and *opportunities of industry.*

Today, a person must buy practically everything that he uses and these items come from a variety of sources. Choices must be more in terms of quality, appropriateness, cost, and expected service. New materials, changing methods of production, and the remoteness of the manufacturer add to the difficulty. The buyer will find that business and selling practices often encourage the consumer to buy to his own disadvantage. These practices include the use of technical terms which confuse the buyer, the use of gadgets that give an impression of a great improvement (automatic clutch on automobile); the modification of design without fundamental change (pseudo streamlining); the substitution of inferior materials (in clothing and furniture); the concealment of unsound construction; high interest rates; and monopolistic prices.

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[2] President's [Hoover] Research Committee. *Recent Social Trends.* p. 277 New York, McGraw-Hill Book Co., 1933.

[3] Public Affairs Committee: *Youth In The World Of Today.* 8 West 40th Street, N. Y. p. 3. The number of young people out of work in 1936 for the country as a whole was estimated at 4,700,000. This means that over a third of all the unemployed in the country are between sixteen and twenty-four years of age.

Basic to buying industrial products discerningly are: a knowledge of techniques of experimentation, an appreciation of design, some understanding of industrial processes, a knowledge of a variety of materials, and some degree of manipulative skill as a "yardstick" for measuring quality of workmanship and appropriateness of materials. A *broad* industrial arts program can offer these opportunities.

b. *The Changing School Population.* Historically speaking, the secondary school is a youngster in the family of public education. Although public secondary schools date back as early as the first quarter of the last century, they were not generally recognized as a public concern until 1880 and later. The junior high school movement is even more recent, starting about 1900 and later.

It is on the secondary level that the increase in school population has been most keenly felt. For example, in the secondary schools of Pennsylvania the enrolment increased 127.9 per cent between the years 1923-1924 and 1935-1936 for grades X to XII, and during the same period forty-nine and two-tenths per cent for grades VII to IX.[4] It should also be remembered that the age of compulsory school attendance continues to rise and hence the numbers attending school increases. It is estimated that approximately 60,000 persons of seventeen and eighteen years are directly affected by recent legislation in Pennsylvania.

As a result, the school has been faced with administrative problems of finance, housing, and personnel and has suffered many disturbances because of these "growing pains." It may reasonably be inferred that there has been little time and opportunity to develop programs appropriate for the rapidly increasing, heterogenous, school-attending group. The secondary school faces an almost immediate task of caring for "all the children of all the people." By "caring" much more is meant than keeping the pupils warm and seated.

In 1890, the persons in secondary schools represented only three and eight-tenths per cent of those eligible to attend.[5] For the most part these pupils were planning to attend college and were willing —perhaps eager—to take subjects very similar to those taught in colleges, or subjects required for admission to college by rigid and academic standards which are *now largely non-existant.* This situation represented a relatively simple problem.

Today boys and girls are practically obliged to attend a specific school and be taught by designated teachers. The group attending is remarkably different as regards backgrounds, ambitions, and capacities. As youth they face significant problems of economic dependence, forced leisure, cultural conflicts, postponed marriage, and the like. Similarly there are social problems impinging upon youth such as those described previously. Many of these pupils are more

[4] Faust, J. Frank. "What the P. S. E. A. Study Reveals." *Pennsylvania School Journal,* 87:3 p. 69, November, 1938.

[5] Koos, Leonard V. and Kefauver, Grayson. *Guidance in Secondary Schools.* P. 1 New York, The Macmillan Co., 1932.

anxious about such problems than with "formal" education today or with "higher" education tomorrow. The secondary school of today is obliged to deal with youth and their problems from a realistic viewpoint. To take youth "off the streets" will prove harmful to both the individual and the school unless the time in school is used to good advantage.

Only a thorough investigation into the needs of youth where they are found will reveal what should comprise the educational program. One is safe in assuming that the secondary school group represents a great diversity of interests, potentialities, and ambitions. There is little reason to believe that narrow curriculums, emphasizing traditional subject matter will serve the interests and needs of youth. Industrial arts and other practical arts find many opportunities to operate in a functional way in the lives of young Americans.

There are other factors that make the teaching of industrial arts a more complicated—yet more interesting—service. Two other such factors are the implications of the democratic concept for school and classroom practices, and the influences of certain learning concepts on teaching. These two items are considered where they are pertinent to content and method.

A very broad and enriched program of industrial arts is implied, if industrial arts is to function in a significant way for "all the children of all the people," industrial arts "content" should become inclusive of various aspects of problems discussed above such as: occupational shifts and employment opportunities, technological changes and unemployment, techniques of good "buying" practices, and the like. Making projects requiring many types of materials *will* provide *insights* into many *industries, will* provide for a *wide variety* of *types of expression,* will offer many *avocational* opportunities, will aid the *consumer* of articles in metal, textiles, clay, and plastics. A comprehensive program is necessary.

B. AN APPROACH TO CONTENT ANALYSES

The organization of an industrial arts program needs to be considered in order to suggest how the subsequent content analyses may be interpreted and used. But it is first necessary to consider this problem from the total-school viewpoint. It is only from this broad perspective that the functional nature of industrial arts is revealed.

Industrial Arts in the School Program. It is difficult to state in a few words how and where industrial arts fits into a total educational program for this presumes that there is one such program. This presumption would be contrary to facts, for programs differ from school to school. Secondary schools, by and large, continue to be organized on some subject basis or a modification of the subject plan.

Industrial arts has often been presented as an excellent "motivating" device for academic subjects—model stages have been built in the

school shop to "motivate" the study of drama. In many such instances industrial arts becomes a mere *handwork* program and serves little better than did the *Object Method.* Teachers of other subjects are usually eager to use industrial arts as such an "auxiliary."

As stated previously, industrial arts is a study of industry as a unit of society and as such has a unique point of view to offer in the study of many problems. The same problem—say, "The Conservation of Natural Resources," may also require a point of view from economics, history, science, or any one of a host of other subjects for more complete understanding. This will make for reciprocal relationships among subjects and subject areas rather than a one-way passage. Problems may arise in the industrial arts work shop and be carried over into science or history just as problems arising in science or history may require industrial arts enlightenment. A *problem* rather than a subject will serve a more natural integrating medium.

Approached from a slightly different viewpoint it may be said that industrial arts becomes an integral part of general education by supporting those educational values or objectives accepted by the school as an *education unit* rather than a collection of subject areas. This implies that each school should have major purposes or "whole school objectives" before any particular subject can be a part of the general-education program. A time honored "academic" subject can be "vocational" in the fullest sense of the word when it seeks to revolve on its own axis.

The nature in which industrial arts functions is not limited to this "correlating" or "integrating" type of activity. The scope of industrial arts in a secondary school is described below in four areas. These areas may be thought of as types of approaches to industrial arts. The word "approach," as used, is not to be confused with the term "course." All four approaches operate simultaneously and an individual pupil may be served by all four. An industrial arts teacher should check himself against this fourfold breakdown to learn whether or not he is preventing his program from taking a tangent direction. Such tangents are in evidence where the offering is so narrow that the pupil does not "see the forest for the trees," and where broad programs are so loosely planned that pupils do not have satisfying experiences.

The statements which follow are in keeping with the principle that industrial arts serves general-education purposes and is an integral part of the educational program.

1. A "Major Problem" Approach. Many secondary schools report having "core" curriculums of one sort or another. The basis for the "core" may be, and often is, some major problem such as "'Housing,' 'City Planning,' and 'Community Recreation.'"[6] The nature of the problem determines what subject-area teachers can

[6] Alberty, Harold. "Development of Core Curriculums." *Educational Research Bulletin.* 17:8::222-231, November 16, 1938.

contribute toward its solution. In the type of problems listed above an industrial arts teacher has contributions to make.

Where an industrial arts teacher is asked to aid pupils in solving such problems it is his function to indicate how and where industry is pertinent to the problem at hand. *All secondary school pupils are likely to be interested in and have need for, this type of industrial arts experience.* Work in the shop is not necessarily involved. Instead, the industrial arts activity may take the form of reading; visiting museums, department stores, mechanical institutes, or industries; or, interviewing persons.

The school need not be organized on a "core" curriculum basis for industrial arts to serve through this approach. An individual's problem rather than a group problem may be the integrating factor. As schools become more genuinely concerned about "individuality," there will perhaps be a more extensive use of individual problems.

2. Broad Industrial Arts Approach. In the first approach the industrial arts teacher is not concerned with having pupils contact a wide variety of industrial arts phenomena of the materials, processes, and products variety. In this second approach the pupil and his needs remain the point of orientation but industrial arts experiences are made available on an extensive basis. *Pupils enrolled in this work are those boys and girls who wish to understand better their industrial environment, through participation in typical industrial activities.* These experiences are not limited to persons with special abilities. Some pupils can profit from this type of work throughout their secondary school careers.

In this "broad industrial arts approach" the pupils should be directed into as many typical industrial experiences as prove worthwhile. Work should not be limited to one or two areas such as woods and drawing, nor to limited experiences within these areas such as furniture making in woods, and orthographic projection in drawing. In fact, the typical areas of drawing, wood, and metal often lose their identity in this approach. That is, an industrial arts work shop need not be thought of as a series of unit shops. A problem or project may call for work in several such areas. There should be no attempt to make persons "specialists" in any one area while this approach is operative.

3. Specialized Industrial Arts Approach. There are pupils in secondary schools who are best served by having more extensive experiences within one or two industrial arts areas such as graphic arts or ceramics. Subsequent to, or simultaneously with, their broad industrial arts experiences these persons are permitted to have these more specific opportunities. It seems entirely reasonable to state that every person graduating from secondary school should have some one interest developed to the extent that he gets pleasure from it

and has developed considerable ability in it. Many persons will choose from music, painting, and dramatics. Others will prefer to express themselves in materials of industry such as clay, woods, metals, threads, paper, ink, type, plastics, and the like. This "specialized industrial arts approach" seeks to care for that large number of persons who are found in the latter group.

Pupils in this category are directed into a variety of experiences within some one or two areas. For example, graphic arts offers work in papermaking, bookbinding, inks, and methods of reproduction in addition to typesetting and letter-press work. While this approach represents specialized industrial arts experiences, it does not lend to narrow, specific education.

4. Hobby and "Free Activity" Approach. Industrial arts serves many pupils who have something to do in connection with a personal or school problem aside from regular school work. Some schools provide scheduled time for this "free work" or "free activity." As regards industrial arts the pupils' chief needs are usually tools and equipment, and the teacher's technical advice. This work is not haphazardly planned or executed—poor or unsafe work habits should not be tolerated—but a minimum of "interference" is essential.

The industrial arts shop or laboratory may become a "work center" for hobbies of the arts and crafts nature. In connection with practically every hobby there is some occasional operation that requires the use of an expensive piece of equipment. For example, many young persons are interested in radio as a hobby but require a periodic use of special radio testing apparatus that the school may own. Or, a pupil may wish to use a press to run off copies of a linoleum block print. Well equipped industrial arts shops have these machines and apparatus available. It is one very effective way to encourage worthwhile avocational interests. There are other arts and crafts opportunities in industrial arts, to be sure, such as clubs and evening classes.

Content Analyses. The content analyses which follow indicate the possibilities within the various areas of an enriched industrial arts program. They do not represent "ground to be covered" nor are the analyses exhaustive in scope.

These breakdowns are of the areas termed: metals, graphic arts, electricity, drawing, and woods. It is not implied that these areas constitute teaching units, but they may be thought of better as "service" areas to the industrial arts program. There are other very significant areas that are not as fully described in this bulletin. Among them are ceramics, power and automotive, textiles, photography, and work with specific materials such as plastics.

C. CURRICULUM AREAS

1. Printing and Other Graphic Arts

To many people the art and science of the printer are unknown fields, and the drama of typesetting, newspaper work, and binding belongs to the mysterious crafts. Yet the symbol of the printed word is one of the most significant things in our civilization, and understanding of the processes and techniques by which type becomes that symbol is a valuable educational experience.

Graphic arts is a comprehensive field and includes many basic processes and products in addition to printing. Graphic arts is defined as:

> Those methods and processes (hand and mechanical) which produce a number of copies of pictorial, decorative, or typographical arrangements on paper or other surfaces.[7]

Photoengraving, duplicate-plate making, binding and related industries of machinery and materials form one area. Print-making methods include steel and copper engraving, and cutting, etching, and lithography. Photography is employed in its various forms. Included also are such commercial processes as: ditto, hectograph, and the stencil processes primarily mimeographing and silk screen printing.

Many schools have limited their graphic arts offering to typesetting and press-work, but, significant as they are, they do not offer an adequate perspective of the graphic arts program; however, less expensive and very important are experiences in paper making, bookbinding, ink making, printing by silk screen and planographic methods, block cutting and the like. Pupils should receive a broader scope of the graphic arts. The printing on wall paper arouses interest in the actual printing of wall paper; interest is also aroused in the printing of cloth for garments, tapestries, and of floor covering, as well as the printed word or illustration. More and more such an interpretation of the importance of printing to modern civilization suggests that girls as well as boys should be offered these contacts.

Every secondary school pupil is concerned with the influences of the graphic arts. *Printing,* for example, not only refers to an industry that produces a consumable product, but the word printing also connotes a *social force* or *agency.* A strict control of the press is essential to dictatorship; freedom of the press is a cherished American privilege. The ideas one forms and holds, the appreciations one has, and the things one buys are greatly influenced by the printed page. These and similar influences may be pointed out by the graphic arts teacher to pupils who are dealing with problems wherein, say, communication is involved.

Where graphic arts is provided for boys and girls on a broad industrial arts basis the work should be directed so that there are many

[7] American Institute of Graphic Arts, New York.

opportunities for contacting various graphic arts areas such as: printing, papers, inks, and binding. Correspondingly, experiences within these areas should be rich. For example, in printing the three basic types: relief, planographic, and itaglio should be represented. Graphic arts should include provisions for studying the romantic story of paper development; manufacturing methods, types of finishes, kinds of paper, and the process of watermarking only part of which can be learned through the actual making of paper.

From the specialized industrial arts approach graphic arts offers many worthwhile opportunities. Anyone of the above mentioned four areas: printing, paper, ink, and binding offers an abundance of opportunities to the pupil who desires to follow a worthwhile interest or talent in the graphic arts. Among the creative hobbies in the graphic arts field there are: wood block printing; linoleum block printing; printed books; miniature books; limited edition publications; special calendars; book plates; printed shawls, scarfs, and mufflers; etchings; drypoints; and lithographs. Hobbyists who center their efforts on collections find graphic arts a fine medium for the development of their interests. Persons report interests ranging from collecting rare edition books to match box labels.

Since graphic arts is representative of so many industries and occupations, ranging from the professional field and skilled trades to that of the semi-automatic or automatic machine operator, the exploratory and occupational guidance possibilities are rich. An expansion of the field due to the new methods, devices, demands, and a low ratio of apprentices indicates that there will be a shortage of skilled craftsmen in the field in a decade from now.

Graphic arts offers many natural openings for relating experiences to other fields such as: history, English, art, mathematics, and science. It is not implied that graphic arts supplants any teaching in any one of these areas. The statements merely indicate the functional nature of this industrial arts area.

a. Historical Relationships. After untold ages man learned to express his thoughts in pictures on cliffs and cave walls. Later he developed knowledge and techniques for marking on substance that could be carried about, such as clay tablets. The fact that man can record experiences and pass the record along to his contemporaries and hand it down to posterity, is more significant to him than all his wars, migrations, and dynasties. The slow toilsome evolution of this new skill of man, from the primitive markings of stylus, brush, and reed pen down through the epochal invention of movable type to the books and the newspapers of the power presses of today can scarcely be understood or appreciated by anyone save those who have contacted graphic arts in some form.

Problems confronting the pupil in graphic arts usually involves an interesting material heritage background. Even the setting of a card may take the pupil into its origin, development, and the change

in typographical styles. What boy has not heard of Paul Revere and the midnight ride that made him famous? How many pupils have heard of Paul Revere as an *engraver* as well? The making and development of bookplates may require much thought on the part of the pupil in the field of history. This is especially true if the design is in anyway associated with heraldry.

b. English Relationships. The relationships between English and graphic arts are apparent. A functional use for English grammer and rhetoric is present in preparing copy, reading and correcting proof, and reporting for school publications. Much that has been written about graphic arts, its origins and developments, and the biographies of those associated with the field represents a very superior type of reading material.

c. Art Relationships. Practically every problem in graphic arts product determines its worth. Thumbnail sketches, rough and finished drafts, "playing" with color combinations and other art experiences are required before the actual development of a printed page, a book plate, a silk-screen layout, or a watermark is undertaken. The pupil is confronted with choices, and problems that require ingenuity. Design, form, and arrangement become meaningful in graphic arts. The very nature of graphic arts tends to develop an appreciation of the beautiful. There is a daily application of the principles of the fine arts to utilitarian articles. Pupils become acquainted with what is beautiful and worthwhile. The advertisement, the book, the appearance of the front page of the paper take on new meaning. The pupils become intelligent and discriminating consumers, if not producers, of beautiful things.

The graphic arts approach necessitates the use of many different tools, materials, and procedures. Linoleum and wood cuts, copper, drypoints, and celluloid etchings are typical graphic arts media that offer many opportunities to the young artist.

d. Relationship with Mathematics. It is difficult for a pupil to plan a booklet, whether printed by letter press or other means, without considering size of page, the amount of space the copy will cover, an estimation of the amount of paper to be used, the method of cutting paper most economically, and marginal sizes and effects. *Bookbinding* makes for many mathematical experiences. These problems are near, clear, and actual.

e. Science Relationships. Relationships here are unlimited. The metals used in the manufacture of type, the ingredients in printing inks, the manufacturing of rollers, the paper and paper making, the bookbinding adhesives, the marbling of paper, the principles basic to lithographing, and the etchings are among those graphic arts experiences wherein science functions.

The number of schools in Pennsylvania now offering graphic arts is relatively few, and these are found predominantly in urban districts or usually in the large cities. The cost of installation has been a factor, but there are many graphic arts experiences that do not involve expensive outlays. Furthermore, when the cost item is considered over a period of years, graphic arts is found to be among the very lowest to maintain.

The precept that the field of graphic arts is rich in educational and inspirational possibilities is well stated in the myriad of references that fills our literature. May we quote Horace Mann, who has been responsible for many of the ideas that form the background of our present school system:

> "Every school boy or girl who has arrived at the age of reflection ought to know something about the art of printing. Printing, the mother of arts, puts us in communion with the great minds of the past and present, preserves the philosophy of the ancients for the future generations. The loftiest spires of mental attainment may be reached through the musical click of the marvelous presses. Printing heralds news of the dying dynasties and broadcasts the upsprings of new and hopeful empires. It flies to seek every soul born into the world."

An unknown author relates through the column of a trade magazine this thought:

> "Printing is the great constructive force in the modern civilized world. It plays the indispensable part in the dissemination of news, in the expression and progression of political ideas, in the records and exchange of commerce and industry. It democratizes education, science, art, music, and broadens the scope of everything it touches. Its service is vital in up-building and sustaining business through advertising." [8]

It seems logical to suppose that the study of an art that has been so inseparably connected with the development of civilization should yield desirable results when used as instructional material. Here should be both stimulus and food for educational growth. The rapid development of printing has played such an important part in the climb of man from the level of the barbarians to the present relatively high state of civilization that the knowledge of its history, men, related arts, possibilities, and production methods should be part of the mental equipment of every educated person.

2. The Metals Area

Industrial arts content changes daily with new inventions and new materials. Hence an outline of an industrial arts area as comprehensive as metals can be suggestive only. Furthermore, there

[8] Printing Education. Vol. VII. N. 5 May, 1931.

is no *one* way to select materials for teaching purposes. These statements are not made to the effect that everything contained herein should be included in the curriculum of any single school. Nor should it be inferred that some unit which may have been inadvertedly omitted from the outline or the text is not worthy of inclusion. The effort is to present what might be termed the raw materials for developing a curriculum in the metals area. This plan challenges the individual teacher to select those units which will function best in his own particular situation.

It is the plan here to divide the metals area roughly into five major divisions; namely, Historical Background and the Importance of the Metals Area, Basic Processes in the Metals Industries, Fabricated Products, Administrative Areas, and Information Relating to Metals of Importance to Producer, Consumer, and Citizen. Each of these divisions is appropriately sub-divided in the accompanying outline. A short statement concerning each of these divisions presents suggestions which may be found helpful in selecting definite teaching units as well as methods in presenting or treating them. It is hoped that these suggested approaches will be enlarged upon by the individual teacher.

a. *Historical Background and the Importance of the Metals Area*

(1) Historical treatment of the basic metals
(2) The development of metal working processes and their effect on civilization
(3) The inventions of machine tools and their economic implications
(4) The age of alloys
(5) The Nature of the expanding uses of metal

(a) Homes
(b) Industry
(c) Communication and transportation

b. *Basic Processes in the Metals Industries*

(1) Reducing the ore

(a) Smelting
(b) Reduction in the electric furnace
(c) Chemical reduction

(2) The making of steel

(a) Bessemer
(b) Open hearth
(c) Crucible
(d) Electric furnace

(3) Reducing to usable shapes

(a) Rolling
(b) Cold drawing
(c) Extruding
(d) Sand casting
(e) Permanent mould casting
(f) Die casting
(g) Cutting

(4) Fabricating Practices

(a) Stamping
(b) Welding
  (a) acetylene
  (b) electric
(c) Spinning
(d) Riveting

(5) Machine Tool Operations and Processes

(a) Drill press
(b) Engine lathe
(c) Tool grinder
(d) Shaper
(e) Planer
(f) Milling machine

(6) Hand Tools, Hand Tool Operations, and Hand Tool Skills

(7) Metal Finishes

(a) Paints, lacquers, and enamels
(b) Electroplating
(c) Etching
(d) Porcelain

c. *Fabricated Products*

(1) Automobile bodies
(2) Furniture and utensils
(3) Steel homes
(4) Transportation facilities

(a) Bridges
(b) Trains, ships, airplanes
(c) Electrical towers

d. *Designated Areas of Metalworking Activities for Administrative Purposes*

(1) Bench metalworking
  (a) Cold metal work
  (b) Decorative iron work
(2) Sheet Metal
(3) Art Metal and Jewelry
(4) Machine Shop
(5) Foundry
(6) Forge
(7) Welding
(8) Heat Treatment of Steel
(9) Metallurgy

e. *Information Relating to Metals of Importance to Producer, Consumer, and Citizen*

(1) Occupational Information
  (a) Working conditions
  (b) Wages and hours
  (c) Collective bargaining
  (d) Employment possibilities
  (e) Occupational shifts
  (f) Cultural opportunities
  (g) Physical requirements including skills
  (h) Mental requirements

(2) Consumer Values
  (a) Methods of evaluating commercial products
  (b) Methods of locating pertinent information on metals
  (c) Specification requirements for ordering metalworking tools and metal products
  (d) Concern for the conditions under which products are made or merchandised
    Sweat shop products
    Health
    Forced labor output

One or more items under each major heading is expanded for the purpose of clarity.

a. *Historical Background and the Importance of the Metals Area.*

Historians divide the civilizations or ages of mankind into—the Old Stone Age, the New Stone Age, the Iron Age, and now the

Electrical Age. The Electrical Age is, of course, simply an extension or ramification of the Iron and Steel Age. Today, steel is the stuff of our civilization. Our American civilization more than any other in the world was built on and by steel. The taming of the continent was largely brought about by iron and steel products. The frontiers advanced hand in hand with the development of metalworking processes and machine tools. Steel is the backbone of our transportation and communication facilities. It is interesting to note in this connection that in 1885 there were one thousand pounds of steel used for each inhabitant and in 1935 this figure was multiplied by seventeen.[9]

Before 1870, steel was in reality a precious metal. It cost almost as much as silver per pound. Up until that time it was made by the pound. While today it is made in one hundred ton lots. Each home uses an average of over six hundred pounds of steel. Steel refrigerators keep our food and beverages cool and fresh. Steel stoves are used to cook our meals, steel furnaces keep us warm in winter, and steel air conditioning systems keep us cool in summer. A hundred times a day we turn to various steel servants to help us with our work or with our play. A steel automobile takes us to a steel office building or steel factory where the chances are seventy in a hundred that our work depends directly or indirectly on the steel industry or that our pay check fluctuates with it. These every day uses of steel should receive very careful consideration when the teaching units in the metals area are selected. The importance of the study of the economic aspects of the various members of the metals group can hardly be over estimated.

Between the mines in Minnesota and the finished railroad rails there are many social, economic, and governmental as well as technical problems which have a direct bearing on the life and economic security of the average American secondary school boy or girl. Some of these problems may be solved in the school shop but most of them must be solved elsewhere, in study, in visits to steel mills, to foundries, to machine shops, to automobile factories, to coke ovens, and to coal mines. Understandings in industrial arts are not confined to the school shops and drafting rooms. The study of steel is especially significant for the boys and girls of Pennsylvania because approximately thirty-six per cent of all the steel made in the United States is made in the Keystone State. The economic aspects of the steel industry can hardly be ignored when a continuous strip mill costs $10,000,000 to build, rolls 600,000 tons of steel a year, reduces costs $6.00 to $8.00 a ton. Labor is practically eliminated, being cut down ninety-seven per cent.[10]

Steel has made a profound change in the rural life of America. It is true that the automobile, the telephone, and the radio have annihilated time and space for the farmer and these in connection

[9] *Building America,* Vol. 2, No. 5, p. 5, New York, N. Y. Society for Curriculum Study, Inc., 1937.

[10] *Fortune,* April, 1936, p. 136, Time, Inc., 135 E. 42nd Street, New York.

with good roads have radically changed his marketing facilities as well as his social life. The farmer's economic security once depended upon human and animal power. Today, it depends more upon fuel and the horse power produced by it. From the tractor which pulls the plow, cultivator, combine, thresher, and feed grinder down to the incubator—a steel mother for his chickens—steel is a very important element in a farmer's life.

b. *Basic Processes in the Metals Industries.*

Iron is the principal metal of this world from the standpoint of use. It is also the most abundant in the form of its ores to be found in the earth's crust. That it also exists on other planets and stars has been proven by the spectroscope and by meteors which reach the earth from outer space. Iron ore is in reality "iron rust mixed with dirt." It is the amount and kind of "dirt" that determines its value.

The principal iron mines of the United States are located in the Lake Superior ranges. Seven-eighths of all the ore mined in America comes from this district. About sixty per cent of this ore is mined with steam shovels from open pits. The magnitude of the iron ore industry is attested to by the fact that our country alone uses 55,000,000 tons of ore a year and that altogether some 500,000 men, skilled and unskilled, do hundreds of jobs necessary to change raw iron ore into finished steel. The ore is first reduced to iron in a blast furnace. From the blast furnace it may be cast into pigs—pig iron—or it may be taken in its molten state to a Bessemer converter or an open hearth furnace to be converted into steel or one of its many alloys, which are then rolled or forged into usable shapes or billets.[11]

It should not be inferred from the above that iron and steel are the only metals or that they are the most important metals to be included in the industrial arts shops. Other metals and alloys which pupils will need to cast, forge, spin, hammer, and plate in solving their problems or in building their projects are: aluminum, copper, lead, zinc, nickel, pewter, brass, tin, babbit, silver, and gold. Several of these non-ferrous metals are superior to iron and steel for school use. For example, copper, pewter, brass, and aluminum excel in the making of art metal trays, dishes, and the like. Their physical characteristics of ductility, maleability, color, sheen, and low melting point make them the leading metals in most school shops.

The most discussed and the most amazing of all these metals, aluminum, has been selected for further consideration. Among other reasons for selecting aluminum are the following: It affords an example of a metal that is extracted from its ores by electrolitic and chemical means. In the relatively short span of fifty years aluminum production has reached fourth place in volume among metals; its

[11] This is a very general picture of these well known processes, but the principle involved is that such information is Industrial Arts content.

output surpassed only by iron, zinc, and copper. Its relative cheapness, its amazing versatility, and its wide use in the American home are other reasons why it ranks high as a raw material for school shops.

The most striking quality of aluminum is the fact that it weighs about one-third as much as other common metals. Combined with its light weight are many other desirable characteristics which have made it one of the most commonly used metals today. Chief among these attributes are: resistance to corrosion, ease of forming and fabricating, low melting point (approximately half that of iron), ease of pouring, machineability, high electrical conductivity, and the variety, and permanence of its finishes.

Recently available texts and instruction units have been published on aluminum which should be a part of every industrial arts library.[12]

A review of the various headings outlined under basic processes in the metals industries will convince the reader that there are many other areas that are as important, perhaps, as the two usually included in most metal shops, namely: machine and hand tool operations. Among the ones which may be specifically pointed out as having particular significance, and which may be included in any metals area with a small capital outlay are the following: sand casting, (aluminum, lead, etc.), stamping, welding, spinning, and metal finishing.

c. *Fabricated Products.*

The automobile assembly line is certainly one of America's greatest contributions to the machine civilization of today. The average visitor to an automobile factory is shown the assembly line and he goes away believing that he has seen how automobiles are made. Unless he is taken behind the scenes, however, he goes home with a very superficial knowledge of the whole process. He has missed the enormous presses with their blanking and forming dies; presses which stamp automobile tops including rear window openings in a single stroke. And he has likewise missed seeing the sparks which are caused when whole sections of the body and frame are electrically welded together in two or three seconds.

Nor is the average visitor to the assembly line aware of the fact that it was made possible by interchangeable parts which in turn depend upon master gages which are accurate to five one-millionths of an inch. In addition to these things there are the automatic and semi-automatic machines which furnish thousands of parts to identical dimensions daily. There are the automatic inspectors which are capable of taking six or more accurate measurements on piston pins and

[12] Hobbs, D. B. *Aluminum,* Bruce Publishing Company, Milwaukee, Wis., 1938. *Design for Piercing, Chasing, and Etching.* Wm. Dixon, Inc., Newark, N. J., 1937.
Alcoa Aluminum and Its Alloys. The Aluminum Company of America, Pittsburgh, Pa., 1937.

reject the ones not meeting specifications at the rate of several per second. Dynamic balancers for balancing crank shafts while in motion not only show how much the piece is out of balance but also place an X on the exact spot that should be removed.

The obvious conclusion here is that the person who goes to visit an automobile factory without preliminary reading or instruction comes away with little more than he went with. If he had no problems when he went he has no answers when he returns. The industrial arts excursion of any type should not be a mere picnic or an outing. It should be planned for weeks or months ahead and should produce the answer to questions relative to working conditions, to the apparent cultural level of the workers, and to mechanical processes.

d. *Designated Areas of Metalworking Activities for Administrative Purposes.*

It is hardly necessary to state that the ideal metal shop is one to which the pupil can go with a problem or project involving one or a dozen metalworking units and return with a satisfactory solution or a completed project. In a setup of this kind, units or areas will tend to disappear and a true metal shop will emerge.

The foundations for an industrial arts metals program rest on the belief that the pupil will have some ideas other than the stereotyped ones usually supplied by the teacher and it is built upon the fact that very few articles of commerce are all castings, or all sheet-metal, and very few indeed are all finish.

Therefore, it is very important in selecting the metalworking areas to be included in any shop to consider the age, interests, aptitudes, and problems of the student. The location of the shop room (adjacent to a chimney for example) will dictate whether or not certain areas may be safely included. Another factor and a deciding one is that of available money. After all of these factors have been weighed and evaluated and only then can an intelligent approach to the question of "what and how many areas" be made.

It may be stated as a general principle that the integrating factor in the metals shop, regardless of the number of areas should be the pupil's problem or project. It follows that the greater the number of areas the more flexible the whole program will be. This flexibility will tend to provide solutions to a wider range of problems and will also provide means for building a greater variety of projects. If possible, equipment to provide experiences in all the areas designated in the outline should be included in the metal shop.

e. *Information Relating to Metals of Importance to Producer, Consumer, and Citizen.*

An approach to the solution of many of the problems relating to the production and consumption of metal products may be made

directly through industrial arts activities in the shops and drafting rooms, and through planned industrial visits or indirectly through consultations between industrial arts and social studies departments. The industrial arts department should provide first hand opportunity for job analysis. This analysis with the help and cooperation of other school departments should present pertinent information on working conditions, wages and hours, collective bargaining, employment possibilities, occupational shifts, cultural opportunities, physical requirements, skills demanded, and mental requirements for the metal working trades. In addition to these, and perhaps more important the school shops will provide opportunity for the pupil to explore his own abilities, capacities, and aptitudes while on the firing line where industry is stripped of its glamour and where the smoke, dust, grime, gasses, sweat, and fatigue, as well as the added requirements of skill, understanding, and perserverance all serve to give a true picture of the requirements of various metal working occupations.

3. The Drawing Area

a. *What Does the Citizen Need to Know About Drawing?*

What use does the average citizen have for an understanding of the common principles of drawing? Wherein can he profit from the ability to read and interpret blueprints and working drawings, to read and understand architects' drawings, to interpret the mass of statistical information presented in graphic form in newspapers and periodicals, to understand and appreciate the principles of design in furniture, pottery, and the like.

Do the answers to these questions point toward an intensive type of work, as for example, one semester spent in learning instrument technique *via* the practice exercise route or a similar amount of time spent in considering the theory and practice of orthographic projection by the wooden object method? Or do the answers point toward an extensive treatment of the entire field of drawing where, for example, map making, duplicating, and freehand sketching should be accorded an equal or a greater amount of time than such traditional units as orthographic and isometric projections? What exploratory and vocational values, if any, will accrue from the intensive type of course? The extensive type of course?

We shall attempt to find answers to these questions in studies that have been made, by specific observations, and by recording expressed need on the part of pupils and adults.

The fact that drawing is a language for expressing one's thoughts or for conveying ideas to other people, in some graphic form, implies a broad conception of drawing. Hankammer's[13] survey reveals some

[13] Hankammer, O. A. "The Derivation of Drawing Content." Western Arts Association Bulletin, p. 153, Vol. XVII, No. 6, December, 1933. H. E. Wood, Secy., Indianapolis, Ind.

interesting facts from a "consumer's" viewpoint. "Some 314,844 square inches of printed matter were measured. Of this amount 89,921 square inches of space or twenty-eight and fifty-six hundredths per cent were devoted to drawing. That per cent indicates, to some extent, how much "picture reading" we do. Another significant fact to note is the relative ratios these various kinds of drawings have in popular reading matter. Briefly summarized we have:

(1) Analytical, one and nine-tenths per cent
(2) Decorative, seven and one-tenth per cent (one-fourth of total).
(3) Graphs, seventeen-hundredths per cent.
(4) Instrumental, fourteen-hundredths per cent (least of all).
(5) Lettering, four and six-tenths per cent.
(6) Maps, twenty-hundredths per cent.
(7) Narrative, fourteen and two-tenths per cent (one-half of the total).

From such an analysis, one cannot escape the conclusion that drawing, as an important tool subject, is a means of interpreting ideas and giving expression to ideas, and should be taught or made available to every boy and girl in the public schools."

The possibilities of the broader type of drawing course have been very well summarized by Hauenstein[14] as follows:

> It is possible, through drawing; to bring into the lives of boys and girls everywhere, a knowledge of the practical things of life and to provide avenues for expressing this knowledge; to develop useful skills for graphic communication through representation, illustration, and design; to do construction in three dimensions; to educate the judgment to keen discriminations and wise choices which will function later, as circumstances permit, in the selection of apparel, the selection and beautifying of the home and garden, and in city planning; to develop skills which will be productive of joy in school life and give resources within which enable one to make worthy and happy use of leisure; to develop useful skills which will lay a foundation for those skills that may be gained later by more intensive vocational field to which they are most naturally adapted; to give the youth the information and experience which will interest him in real situations and enable him to do more effectively the things that most individuals are called upon to do without respect to their vocation.

These findings and views are further substantiated by the findings of Magill.[15]

[14] Hauenstein, E. A. "Public School Applications." Western Arts Association Bulletin, p. 153, Vol. XVII, No. 6, December, 1933. H. E. Wood, Secy., Indianapolis, Ind.

[15] Magill, W. H. *The Determination of the Graphic Forms and the Frequencies of the Forms Employed in the Current Reading Matter of the Non-Specialist.* Published by W. H. Magill, University of Pennsylvania, Philadelphia. Pa., 1930.

What American family has not had to plan a home, a garage, or a sidewalk, or at least had to approve or disapprove plans made by others? Then there are many less ambitious plans than that of a building where a knowledge of the fundamental principles of projection will serve the average person who wants to change a partition or even the furniture in a room. It is a relatively simple matter to draw a plan of a room to scale and to reduce the furniture which one already has or expects to buy to a like scale on pieces of colored cardboard and by arranging and re-arranging them reach an intelligent conclusion about furniture location without calling in the movers or knocking a single hole in the plaster. It is certainly within the province of industrial arts drawing to provide experiences whereby all pupils have an opportunity to do this type of work.

Drawing may be thought of as a "language" and one who engages in learning its symbols and techniques is in reality extending the scope of his "reading" and "writing" and is providing himself with a new avenue for expression. An avenue which, by the way, is universal in the sense that the principles of drawing and projection are not peculiar to a certain nation or people as is a language. (English, French.)

While the pupil has occasions to read as well as to express his thoughts in drawings from earliest childhood, the need for an understanding of this graphic language becomes particularly acute when his problems require actual shop or laboratory work. Drawing is the language of the school shop as well as the language of industry. Therefore, a unit in the reading of drawings and in the interpretation of instructional materials is a prerequisite to effective industrial arts work. A few of the basic principles of drawing are necessary before the pupil can work from another's plans or before he can plan his own work. The ability to make and interpret drawings or blueprints bears the same relationship to industrial arts work that the ability to read at all bears to geography or arithmetic.

It should be pointed out here that many people have more use for the knowledge of reading and understanding drawings than for making them. Hence, the desired objective might stress reading ability and freehand sketching more than the ability to make neat and accurate instrumental drawings.

Many household utensils and appliances have included with them a set of directions and working drawings which must be interpreted before the article can be assembled or used. This unit in the reading of drawings may include many different types of drawings such as: architectural, graphs, diagrams, topographic-maps, working drawings, narrative drawings, furniture drawings, and many others.

The importance of freehand sketching as part of industrial arts drawing can hardly be over-emphasized. It has a definite purpose and place in every drawing course. Many times it is used to advantage in our everyday living. As one talks with another person explaining some article, piece of furniture, or floor plan of a new

home visited, the other person receives a clearer mental picture when a sketch is used. It also serves as an aid for conveying information from a salesman to a buyer, foreman to worker, and teacher to pupil. In the industrial arts course it is used for working out the design of a project, such as the curved top of a whatnot shelf. It is often used for recording information outside the drawing room and used later for making the finished drawings from the sketches and notes. It is frequently used as the preliminary step in laying out a drawing. The ability to make free-hand sketches is an asset for anyone and practically a necessity for persons engaged in any type of mechanical work.

It should be apparent to the reader that industrial arts drawing includes a broader range of topics than the conventional mechanical drawing courses which in many cases consist primarily of instrumental drawing and orthographic projection plus some lettering. Some of the areas having particular industrial arts significance have been discussed above. Hauenstein[16] lists a total of twenty-two areas that he has included in the drawing course, namely:

1. Layout exercises
2. Lettering
3. Shape description
4. Geometric constructions
5. Color values
6. Inking
7. Developments
8. Free-hand sketching
9. Working drawings
10. Design
11. Furniture drawings
12. Architectural drawing
13. Duplicating
14. Map drawing
15. Graphs and charts
16. Block printing
17. Commercial art
18. Cartooning
19. Etching
20. Chalk talk exercises
21. Term project
22. Special drawing

b. *The Drawing Room*

This suggested change of emphasis in drawing content and in drawing procedure also implies a new and different type of drawing room. The drawing room should be thought of as a planning room with appropriate facilities for planning and research.

The traditional type of room is much too formal in appearance and too meager in equipment for the program that has been outlined. Since the appearance and usefulness of a drawing room depend largely upon sufficient natural and artificial light it might be well to point out first that there is an optimum number of foot-candles suggested for such rooms. The company supplying current in most Pennsylvania communities will furnish lighting data free of charge to school authorities.

[16] Hauenstein, E. A. Western Arts Association Bulletin. Vol. XVII No. 6, December, 1933. H. E. Wood, Secy., Indianapolis, Ind

The cheerfulness and character of a drawing room depend also on additional elements. Among the most important of these are pictures, statuary, and murals. It is suggested that these be selected to create an atmosphere that is stimulating and conducive to thoughtful, careful planning.

Worthwhile planning requires reference materials of many types. There are the books and magazines to be sure, but for effective work these must be supplemented by many additional types of materials. One corner of the drawing room might resemble a museum of science and industry with models of engines, airplanes, bridges, buildings, and the like. Another corner might be patterned after an industrial laboratory to provide for research and experimentation on related problems. One shelf or table should be well laden with plaster miniatures of historical buildings and of buildings having recognized architectural merit. A trip to an architect's office will suffice to convince the teacher that this is a desirable addition to a drawing room, and it will also provide ideas that can be profitably used in making school work more interesting and more effective.

The duplicating unit will require more than a sun frame for making blueprints. Provision should be made for experiences with all the common duplicating processes. Some of these processes in addition to blueprinting are: ozolid, "Ditto," "Mimeograph," silk screen, stencil, block print, photography, photoengraving, and etching.

In conclusion, it should be pointed out that drawing is a much broader and more inclusive industrial arts area than the so-called "mechanical drawing" of the traditional type. The integrating factors in this newer type of drawing are the pupils' problems and the problems arising from daily living. The units listed in this section are much more interesting and significant from both the teaching and the learning standpoint than are the traditional units which consisted of orthographic and isometric projection.

The drawing room itself is different. But it is little if any more expensive to equip and the results obtained in it more than offset any cost differential.

4. Other Areas

Other industrial areas which may be represented in the industrial arts work shop are: electrical, woods, ceramics, power and automotives, textiles, photography, and work in plastics.

Electrical

Upon what basis should the content material in the electrical area of industrial arts be organized? An examination of the activities usually engaged in by pupils in a great many schools discloses the fact that bell and light "wiring" constitutes a large part of the offering in electricity. That this represents but a small part of the great field of electricity and constitutes a very meager program is readily apparent.

The term "handyman ability" is frequently met with in educational literature to describe what is probably a worthwhile industrial arts objective. While the development of handyman abilities may be a legitimate objective for industrial arts as a whole it is extremely doubtful if this is a desirable end product in the electrical area. Indeed, the old adage, "a little knowledge is a dangerous thing," is particularly applicable to teaching wiring in a school shop.

A simple analogy will serve to illustrate this point. A pupil may, through experience gained in industrial arts, repair a leaking faucet, refinish a piece of furniture, or mend a cooking vessel in his home. These home activities may or may not be successful depending upon the ability of the pupil and the criterion used to measure success. In any event, no lasting harm can ensue if the undertaking is unsuccessful, or if the standard of workmanship is poor. However, should the same pupil, because of having done some wiring on an exercise basis in a school shop, attempt to install an additional light or convenience outlet in his own home the result may not be so harmless.

Electric wiring requires considerable skill and knowledge of building construction. For this reason, extensions or additions to the electrical system of buildings should be undertaken only by qualified electricians. In many communities this is made mandatory through inspection bureaus which limit all electrical construction to registered electricians or electrical contractors and even the work of these qualified and certificated electricians must pass a rigid inspection before being placed in service.

Since the conditions met with in practice cannot be duplicated in the average industrial arts setting it is obvious that something more than an understanding of circuit layout and a knowledge of materials and procedure is a requisite to successful installation of electric wiring. Even though a light or convenience outlet installed by an amateur may operate successfully from an electrical standpoint, this does not insure that all the mechanical requirements for safety have been complied with. Since the greater part of all electrical wiring is concealed behind walls and under floors the potential danger from improperly installed wiring may well be understood. The handyman who repairs the faucet or refinishes a piece of furniture may, if he does a poor job, waste his time and materials, but the amateur electrician presents a greater hazard to more costly property and may even endanger human life.

If because of safety considerations, electric wiring should be eliminated or greatly curtailed in industrial arts program, can the retension of the electrical area in industrial arts programs be justified? Not only can the retention of the electrical area be justified but adequate reasons can be advanced why it should be greatly expanded. Indeed, it may well become the focal point around which to center many of the manipulative activities of the other areas in the industrial arts programs. As has already been intimated wiring is only a means for distributing electrical energy and in itself comprises but a small part

of the activity of the people engaged in the electrical field. If the thesis, outlined in earlier pages of this bulletin is accepted, namely, that industry and the effects of industry on society and the individual should constitute the core of the industrial arts program, then assuredly electricity must play a prominent part in the development of such a program.

None of the industrial areas represented by industrial arts activities, with the possible exception of the graphic arts, affects the lives of modern men in as many ways as does the electrical industry. Actually some industries are so dependent upon electricity that they would be non-existent without its aid. The *radio* and other forms of *communication* would be impossible without electricity. *Transportation* would be seriously crippled without auxiliary electrical equipment. Many *household conveniences* as well as those in stores and offices would cease to be available without the service of electricity. Electricity as a connvenient means for transmitting power could not be efficiently replaced by steam or internal combustion engines. Many products, particularly metallurgical products, would be prohibitive in price without electricity. These and numerous other examples which will no doubt occur to the reader will serve to show how indispensable electricity should become the common heritages of those who aspire to claim a semblance of culture in an industrial civilization.

For what is electricity used and how can one gain an understanding of these uses? Basically, electricity has only three uses—to furnish heat, light, and power. Although all of these uses of electricity are found in the average home, household electrical appliances illustrate but a few of the many diverse uses of electricity. For example, heating devices in the home will not illustrate the uses for the electric arc, the different kinds of induction furnaces, the manufacture of such products as carborundum or graphite, nor will it serve to make one conscious of the possibility of the various kinds of electric welding; yet these are all everyday applications of electricity to industrial processes. Likewise, a consideration of the common incandescent light bulb, so common in the home, does not further one's knowledge of the new mercury or vapor lamps operating upon an entirely different principle. However, these new developments on the lighting frontier will no doubt greatly influence the light sources used in our homes during the years ahead. Electricity as a source of power is represented by more diverse types of motors than are found on family washing machines or vacuum cleaners. The entire field of electro-chemistry is dependent upon electric power, but this phase of the electrical industry is seldom represented in school shops.

If the investigative propensity of youth is stimulated and properly guided, it would seem that the implications arising from a broader consideration of electricity as a source of light, heat, and power should lead to constructive thinking upon pertinent contemporary problems. For example: What influence will electric welding have on the development of prefabricated steel homes? How has electricity affected

the price of aluminum and in turn what meaning has this for aviation? What are the possibilities of the newer types of lighting in the home? What modifications must be made in homes to secure the greatest comfort and convenience from the use of electricity for lighting, air-conditioning, and refrigeration? Briefly then, the electrical area should propagate social thinking, it should provide a place where a pupil can gain a broad industrial viewpoint. In addition to these functions it should provide the means for orienting youth toward the tentative solutions of many guidance problems.

The generation, transmission, and distribution of electricity should also receive attention. Here again, these phases of the electrical industry should have wider connotations than merely technological considerations of generators, batteries, and systems of wiring incidental to the use of electricity. The social implications arising from studying the merits of various sources of power, the relative costs of operating steam, and hydro-electric plants, an impartial comparison of private versus municipal electric plants, and investigations of labor, wages, and working conditions in the electrical industry will be of more significance to a greater number of students than will theoretical principles of electricity.

The field of communication uses electricity for producing heat, light, and power, but the application of these to thermionic vacuum tubes, photo electric cells and relays is so complex that communication cannot be included with the divisions already listed. The part played by communication in present-day society is well recognized although there are many who are not aware of new developments in signaling, telephony, telegraphy, the radio, and the art of television.

In addition to the six fields into which electricity has been divided —generation, transmission, and distribution, heat, light power, and communication—there are many miscellaneous and unusual uses of electricity that are becoming increasingly important. Among these may be cited: "talking pictures," the X-ray, electric dust precipitators, and the applications of electricity to medicine and surgery. The last named application illustrates a contribution that the electrical area can make to consumer education. Many electric "trick boxes," sunlamps, exercising machines, and violet-ray equipment of doubtful value are foisted upon the public by clever advertising. An investigation of some of these in the school shop would provide the student a basis for intelligent discrimination when buying electrical equipment.

The position of electrical theory is reversed and considerably minimized in a program as outlined here. Instead of being imposed from above by the teacher, as a prerequisite to the more interesting manipulative work, the study of theoretical electricity is an outgrowth of the need for such information, on the part of the student, in solving current problems.

Three reasons may be assigned for this attitude toward the teaching of electrical theory: (1) It is in keeping with accepted psychological concepts and therefore may be considered good pedagogy; (2) it pro-

vides for individual differences by offering an opportunity for the more capable pupil to gain a greater insight into theoretical principles than his less academically minded brother; and, (3) it offers to the pupil who has tentatively selected electricity as a vocation the opportunity to investigate the academic phases of his chosen field as a means of further guidance without imposing such study upon uninterested or less capable pupils. It is not to be inferred from what is said here that basic principles governing the operation of common electrical equipment is to be neglected. The contention is made, however, that the principles underlying most electrical equipment can be explained in simple non-technical language. Just as a person learns the meaning and use of common Latin terms and phrases without years of study of the language, so can a person become literate regarding modern industry without being bored with tiresome theory.

One other thing remains to be discussed in connection with the electrical area in industrial arts—How can the ideas embodied in the preceding pages be realized? The nucleus around which revolve all the activities of the electrical area and from which evolve all the concomitant social-economic learning values is the *problem* or *project* upon which the student is engaged.

The school administrator reading these pages may assume that to achieve such a worthwhile program will be beyond the grasp of any but the most wealthy school districts. This need not be true. The complete equipment of tools and materials for the electrical area will cost no more than will other similar areas in industrial arts. Where electricity is to be added to activities already established the cost will be less than for almost any other industrial arts activity. The reason for this being that most of the hand tools and many of the machines such as lathes, drill presses and grinders used in electrical shops are common to the woods and metals areas and can be used in common with them.

While it necessarily follows that in education, as in other services, one gets what he pays for, the returns from a forward-looking program in industrial arts are much greater than the cost of such a program would lead one to believe. In districts where it is necessary to economize, a large portion of the available funds should be used for paying the industrial arts staff. This is necessary in order to secure competent teachers who have ability and initiative greater than is indicated by mere certification. Such teachers are worth the added expenditure because of their ability to compensate for a dearth of equipment and supplies.

The suggestion has been made before that the electrical area can be the nucleus for many industrial arts problems. This is not only true because of the importance of electricity, but because of the nature of the activities to be carried out in the electrical area. An analysis of typical projects made in the electrical area such as toy motors, soldering coppers, lamps, toasters, and radios involve many operations in their construction which belong primarily to other areas. Indeed, with

the exception of wiring, the winding of coils and heating elements constitute almost all the operations which might be classed as belonging exclusively to the electrical area. Likewise, the tools used by the electrical worker are invariably those used by the workers in other crafts. This fortunate combination of operations and tools may well be capitalized to further integration between activities within industrial arts.

A program for the electrical area based upon an analysis of the functional use of electricity will undoubtedly lead to a greater understanding of the value of electricity to civilization than will a program based upon "bell and light" wiring or the making of a project as an end in itself. In other words, the electrical area in industrial arts should not teach electricity, but the electrical industry and the relation of the industry to society and the individual.

Woods

Woodworking is a time honored activity in school shops. As such it has become firmly intrenched in the school program. Because of the sanction of time it has been least affected by the prod of constructive thinking, and wood continues to be the most common medium for expression in many industrial arts shops. This may be explained in several ways. Although more expensive now than formerly, lumber is still comparatively inexpensive. It is readily available to even the most remote school. It is one of the least refractory of school shop media. The tools used in woodworking, particularly for hand woodworking, are relatively cheap, and easily procured. This together with the hope of having boys become skillful in their use for home repair jobs, has often been a deciding factor in convincing objectors of the value of school shopwork. Furthermore, simple woodworking can be done successfully with only hand tools. This has influenced many schools, when choosing areas of activity, to start with a woodworking shop with the well-intentioned plan of adding other areas as finances permitted. Frequently these other areas never materialized. Often this was due to inertia, but frequently the sterility of woodworking as commonly taught prejudiced the minds of administrators against the shop program.

Does it necessarily follow that because prevailing methods and curricula materials in woodworking are deemed inadequate woodworking has no place in industrial arts? As long as wood is used by industry and man has an interest in forest products, such an assumption is untenable in the light of current industrial arts philosophy. Of what then should the woods area in industrial arts consist?

Excellent volumes have been written on the subject of hand and machine tool operations. Additional volumes have been offered on specific fields of woodworking such as cabinet making, patternmaking, and carpentry. Courses of study in great variety have been prepared to cover each field as well as to outline general courses based upon selected units from each. Since this mass of material is at hand it would be presumptive to attempt to outline in detail of just what the

subject matter in the woods area should consist. However, one may say, without fear of successful contradiction, that no single text or course of study now available can be adopted in its entirety and serve as the course of study, *par excellence,* for all school situations.

Instead, it is the province of this bulletin to point out significant uses for wood, and wood products, the implications such uses have for education, and how industrial arts can capitalize on such uses to further the educative process. Manifestly it is impossible to list here all the possible uses for products of the forest. Therefore, only a few will be offered to illustrate the type of material that may become the woof, if not the warp of the woods offering.

It is well known that timber, planks, and boards, are obtained from the trunks of trees. Is it not equally important to recognize the use of forest products as food, spices, and cellulose; and, the sources for such materials as turpentine, rosin, rubber, and varnish ingredients? What long range social effect will the culture of tung trees in the deep South and soy beans in other parts of the United States, both of which contribute to the manufacture of finishing materials for woods, have on contemporary American life? What is the significance to the printing industry and hence to society of the recent discovery that quick-growing Southern pines may be used to manufacture newsprint paper?

The rapid depletion of forest resources has furthered the use of lumber waste products chief of which has been the use of sawdust and shavings to manufacture fiber board and insulating material. Even the bark of trees is used to cap bottles and tan hides. Do these lesser known uses of forest products contribute deeper meaning to the term industrial arts? If they do, then the definition of wood utilization must be expanded to circumscribe all the uses of forest products that are socially significant.

A consideration of wood products leads naturally into the attendant problems of veneering and veneer cutting, the use and manufacture of laminated wood, logging and the preparation and marketing of lumber, forestry, and kindred subjects. These in turn may eventuate in a contemplation of questions relating to conservation with its ramifications in flood control, soil erosion, and reforestation. These broader interpretations of wood in the industrial order cannot be incorporated in a rigid course outline. Nevertheless a good industrial arts teacher is prepared to "go along with" the socially conscious pupil who allows his thinking to transcend the orbit of the shop or classroom.

The opportunity for furthering consumer knowledge and appreciation is unexcelled in the woods area. Although the per capita consumption of wood products has decreased in recent years a great many articles in and about the home are still made from wood. Should not all consumers have the opportunity to learn the advantages as well as the disadvantages of wood as a medium for the fabrication of articles in daily use? Is there a better way of gaining such understanding than by working with the material itself? Experience has shown that students who have had the opportunity of working with many kinds

of woods gain a more meaningful understanding of their physical properties than do others who acquire only verbal information of such properties. A student who carries through a problem of furniture construction finds himself or herself in an ideal situation to investigate suitable woods, to experiment with appropriate finishes that protect or enhance the beauty of the surface, to study methods of upholstering, and to become familiar with furniture styles.

The contributions of woods to other school areas are unique. From the planning or drawing area problems of architectural drawing may be brought to receive contributions from the woods area. Varnishes and glues made in the chemistry laboratory may be objectively tested in the woods area. Scientific principles studied in physics may be realistically seen in tools and machines and portrayed in shop processes. Here also principles learned in the art and homemaking areas may be tested and even geography comes to life in materials from far places.

Although not specifically mentioned before, the guidance or exploratory function of this area is of great importance. Here the manipulative activity is directly related to carpentry, cabinetmaking, and pattern making while, indirectly, opportunity is offered for contact with many subsidiary occupations.

Ceramics is an inclusive term. Under it are classified all manufactured products which are developed from non-metallic, inorganic materials by means of high temperature treatment in some phase of the manufacturing process. Ceramic products may be divided into four categories: namely, (1) clay products; (2) glass products; (3) enameled metal; and, (4) cements, limes, and plasters.

The cost factor has hindered the development of ceramics in industrial arts work shops. Until recently there has been very little equipment on the market suitable for school use. Satisfactory kilns, for example, have been priced upwards of several hundred dollars. Within the past several years kilns, potters' wheels, ballmills, and other necessary pieces of equipment have been designed for school use and are quoted at prices that make them available.

Many elementary and secondary schools report excellent ceramics programs of the "clay products" type. That is, the manipulative work centers around art pottery, tableware, and tiles. Sculpture work and modeling are typical activities, also. Clay is unexcelled for its creative expression possibilities. Many persons who cannot express themselves in two dimensions as in painting and drawing, find the "three dimensional" clay a very workable medium. Design is an essential element in each piece made.

Ceramics represents one of the nation's leading industries. As a major industry it has its own unique occupations, methods and processes of production, and working conditions and problems. Ceramics is closely related to the electrical, automobile, steel, advertising, and many other industries; and to specific trades such as the structural and building trades. An industry as comprehensive as ceramics deserves

the attention of an industrial arts program that attempts to provide exploratory experiences.

As a consumer one buys and uses many ceramic products. The bricks of the building wherein the reader may be located are a ceramics product. The steel in one's auto or razor blade was melted in a ceramic refractory. Other common ceramics products are: window glass, kitchen and cooking ware, abrasives, lenses, laboratory equipment, spark plugs, sanitary ware, and dental porcelain,—to mention only a few. Even this brief listing has definite implications for the so-called "consumer" function of industrial arts.

Because of its expressional, exploratory, and consumer-education possibilities ceramics cannot be justifiably overlooked in planning an industrial arts program.

Layout and equipment information is available in the Department of Public Instruction concerning ceramics.

a. *Power and automotives.* A challenging area for industrial arts development. On many occasions elementary auto repair and the assemblying of a stock motor have constituted the industrial arts offering which is commonly called "auto mechanics." This approach tends to overemphasize the importance of the so-called "handyman" contribution of industrial arts. It also neglects to recognize the change in automobiles as regards reliability and as regards the close adjustments required on automobiles. The modern automobile is accurately made and sensitive, so that it deserves expert attention and requires the use of testing apparatus to make proper adjustments. This viewpoint does not discredit or minimize the practice of having pupils learn some of the principles of the gasoline engine by dismantling and assembling a motor, but it does indicate that such an offering is not adequate in itself.

Further progress should be made to include a variety of power sources so that pupils can experience the principles incorporated in different types of combustion engines. Automotives as such deserves considerable expansion. For example, there are many tests that can be made in the school shop on automobiles that will yield information of importance to the consumer. Then, too, instruction in safe driving has become an accepted industrial arts activity in many school systems.

Some industrial arts programs show developments of a "transportation" area in which automotives becomes just one group of experiences. In one breakdown of "travel and transportation" the major headings are: highways, railways, waterways, and airways. Under each of these headings there is a comprehensive list of types of transportation. Each one is suggestive of investigational studies, and historical considerations as well as work shop experiences of a manipulative nature.

A field as rich as transportation, or from a limited viewpoint, automotives, should certainly not be limited in its representation to the typical motor-assembly type of experience.

The *textile* industry affects everyone for it produces many clothing articles; house furnishings such as carpets, rugs, upholstery, tapestries, linens, and other common fabrics; and industrial items such as belts, tires, and airplane covering material.

In addition to being a major industry many of the textile processes and other activities related to the study and use of textiles are available for industrial arts teaching. There are few communities that do not possess at least one loom and one or more weavers. Looms may be constructed easily, or purchased at little cost. The price of materials for weaving is not at all prohibitive and finished products have intrinsic value.

Various tests may be made with woven products in the industrial arts work shop to determine their wearing qualities, their makeup, and the characteristics which different threads exhibit. Studying different weaving patterns by actually weaving them makes for a greater appreciation of the many fabrics one observes. Even in elementary schools studies are carried on in which children participate in every step of the making of a piece of cloth from the preparation of the plant or animal fiber to the woven product. The historical background of textiles is very rich since weaving is one of the most ancient crafts. The design and avocational possibilities of textiles are practically unlimited.

b. *Photography.* Modern industrial arts work shops show provisions for photography. A small dark-room with running water, several shelves, and some provisions for ventilation constitutes practically all the "bulletin" equipment necessary for the activity. Photography is representative of a very large industry including moving pictures, and is a readily available avocational possibility.

c. *Plastics.* New industrial materials are being developed continually. Many of these new materials do not lend themselves well to school use, and others do not involve experiences or offer opportunities that are not already provided.

However, the field of plastics represents a product of the chemical industry that has been found very appropriate for industrial arts purposes. Several of the plastics are very workable mediums and can be shaped with woodworking and metal tools. They lend themselves well to artistic expression and because of the limited number of tools and equipment necessary make for excellent craft and hobby interests.

Plastics continue to show increasingly greater trade applications. Their uses vary widely—jewelry, containers, radio cabinets, and automobile appointments are among the common uses while major pieces of furniture are now available, and one automobile manufacturing company reports the development of a plastic suitable for automobile body construction.

D. PRINCIPLES PERTINENT TO METHOD

Throughout the preceding pages much has been said about the need for enriched industrial arts programs. Method is as necessary a part of this enrichment as is content or equipment. In fact many teachers develop excellent programs with little equipment and with content restrictions. It should be remembered that good teaching methods are as important in industrial arts teaching as in any subject since the same possibilities of confusion, discouragement, and waste of time prevail.

Method differs from content in several ways. One important difference lies in the fact that whereas content is generally a *means;* method is usually an *end* or both means and end. Stated differently, the instructional materials one uses—products made, information covered, problems solved, et cetera, are experiences that lead to certain goals such as: Skill development, understandings, techniques of problem solving, and the like. Method, on the other hand, not only functions in the experience but continues as an end product. If, for example, a school objective is the development of the scientific attitude and method then situations are provided wherein the scientific method actually operates. If manipulative skill development is the desired end then experiences are necessary where this skill is an essential means. From a long range viewpoint the "process" values of education, that is, ways of doing things (methods) are more important than strictly "content" values. This is especially true from a quantitative standpoint.

The term *method* has lost much of its Herbartian significance whereby lesson plans were made and rigidly followed. The tendency is increasingly toward the proplem approach in teaching and learning. Solving problems is a form of inventing and inventions do not lend themselves to rules or steps of a compartmentalized sort. Problem solving is not a haphazard affair, but the elements of analyzing the situation to see where the problem lies, of gathering information, and of coming to conclusions or finishing a product demand flexibility that formalized procedures do not permit.

There are so many variables in the teaching and learning process that the absurdity of giving specific advice is readily apparent. It is relatively easy to outline a way of teaching where content and method can be separated. However, it becomes difficult to do when one accepts the previously mentioned thesis that *what* one teaches and the *way* one teaches are mutually interdependent.

There is some controversy in the field regarding the so-called *psychological* and the so-called *logical* approaches in industrial arts teaching. The psychological approach is characterized by research as a basic method; the logical approach is characterized in industrial arts by demonstrations, lectures, jobs, workbooks, and the like. Such a controversy seems unwarranted and the difference is likely due to a play of terms. To characterize one method as psychological is to imply

that all others are not psychological. But, as a matter of fact, a demonstration can and should be given under the best of psychological conditions. Problems should serve as the basic unit of organization of industrial arts programs, but specific direction and detailed guidance will continue to be necessary.

Objectives. Education requires direction and direction is offered through objectives. Objectives not only offer direction but also provide: (1) a basis for making choices; and (2) a means for evaluating one's success. When one has an abundance of materials from which to select, objectives are absolutely essential.

Educational objectives are in abundance. They may range from "Sending Johnny to school so he won't have to work as hard as his father" to "Building a new social order." Stated industrial arts objectives vary from: "To learn to tin a soldering copper," to "To train in habits of order, exactness, cleanliness, and neatness."

There are many lists of industrial arts objectives available. Warner's study,[17] for example, reveals not only a list but a rating in importance of objectives. The rating was done by a group of industrial arts people who, it was assumed, "represent the best opinion available today."[18] A list of objectives for industrial arts may be found in Part I of this bulletin.

Having an objective does not necessarily mean that it affects one's teaching. Smith[19] visited eighty-seven schools in eight states and reports that upon asking industrial arts teachers "What are you trying to teach these people?"[20] a statement of professionally formulated objectives was usually forthcoming. However, upon seeking evidence of their achievement he "inclined to question that the explorational objective [the one frequently mentioned] is stressed."[21] The same report applied to some other "time honored" objectives.

Basic to achieving an objective is an understanding of what it means, of the kinds of behavior it implies, of instances (learning experiences) wherein such behavior may be practiced, and teaching techniques that may be functional in achieving that objective. This means that the teacher should be active in establishing and interpreting his objectives.

One cannot analyze industries, occupations, or uses of certain industrial materials and through this analysis arrive at objectives. To attempt to do so would correspond to the hopelessness of expecting to find the north magnetic pole within a compass. Arriving at objectives involves considerations for: (1) The nature of the society in which the school functions stated in terms of ideals and what these ideals mean for school practices; and, (2) the nature of the individual and the learning process stated in terms of potentalities and needs.

[17] Warner, William E. *Policies in Industrial Arts Education.* Chapter V. Columbus, The Ohio State University Press, 1928.
[18] Ibid. p. 36.
[19] Smith, Robert E. "Teaching Methods which Increase Industrial Arts Achievements." *Industrial Arts and Vocational Education,* 27:5::185-188, May, 1938.
[20] Ibid. p. 185.
[21] Ibid. p. 185.

It is assumed throughout this section of the bulletin that a professionally prepared teacher is capable of planning with the pupils a program that best meets their unique situation, provided pertinent information is at hand. This may be compared with the reasoning that the doctor who is present to diagnose a patient's condition can prescribe treatment better than a "patent medicine" man who attempts to use one remedy for all ills. Determining objectives is an essential part of planning a program with the pupils. To state definitely what is meant by "professionally prepared" would be difficult, but such a teacher should have at least: (1) Some concept of the needs of society; (2) an understanding of principles of learning and individual nature; and (3) a knowledge of procedures essential for teaching and learning.

Evaluation. "What we test determines what we teach" is a commonly used expression that bears much truth. The term evaluation implies considerably more than tests and testing but the relationships among *evaluation, teaching,* and *learning* remain direct.

Evaluation is a comprehensive field in itself and is deserving of careful consideration by the industrial arts profession. The various ramifications lie beyond the scope of this bulletin; the reader is referred to the sources cited below.[22]

Evaluation procedures, as later described, perhaps grew out of the recognized need for determining how successful the school is in achieving the so-called "intangibles." Schools have long held objectives such as *citizenship* and *ethical character* without defining the terms and without seeking evidence of their achievement. A program of evaluation attempts to "measure" all of the aims or purposes held by the school and is not limited to those involving memory of content.

Evaluation has two interrelated aspects; one cannot be rightfully considered apart from the other. From one point of view evaluation is a definite and important part of the learning process. In a complete

[22] Grim, Paul R., "Techniques for the Measurement of Attitudes in the Social Studies," *Educational Research Bulletin,* 15 : 95-104, April, 1936.

Lindquist, E. F., "Changing Values in Educational Measurement," *Educational Record,* 17 : 64-81, October, 1936.

Progressive Education Association, *Interpretation of Data,* Bulletin No. 3, October, 1935.

Progressive Education Association, *Application of Principles,* Bulletin No. 5, December, 1936.

Progressive Education Association, *Measurement of Interests in the Arts,* (Genevieve L. Coy), 1937.

Tyler, Ralph W., *Constructing Achievement Tests,* Columbus, The Ohio State University, 1934, p. 102.

Tyler, R. W., "Defining and Measuring Objectives of Progressive Education," *Educational Research Bulletin,* 15 : No. 3, p. 67-72, March 18, 1936.

Tyler, R. W., "Evaluation—A Challenge to Progressive Education," *Progressive Education Magazine,* 8 : 552-557, December, 1935.

Tyler, R. W., "Measuring the Ability to Infer," *Educational Research Bulletin,* 9 : 475-481, November 19, 1930.

Woodin, V. F., "Research Needed in Interest Evaluation," *Educational Research Bulletin,* 16167-71, March, 1937.

Wrightstone, J. W., "Achievement in Conventional and Progressive Schools," *Progressive Education Magazine,* 13 :389-395, May, 1936.

Wrightstone, J. Wayne, *Appraisal of Newer Elementary School Practices.* New York, Bureau of Publications, Teachers College, 1938, 221 p.

Wrightstone, J. Wayne, *Appraisal of New Practices in Selected Public Schools,* Bureau of Publications, Teachers College, Columbia University, 1935, 117 p.

Wrightstone, J. W., "New Tests for New Needs," *Educational Method,* 15 :407-11, May, 1936.

learning situation one defines a problem, sets up hypotheses, plans his procedures, gathers data, comes to conclusions or finishes his product, and then evaluates his efforts, product, and/or conclusions. This is not to be confused with "pupil-grading of projects." Evaluation as described involves the pupil directly. He is concerned with such things as: how efficient he has been, what shortcomings he has exhibited, how reliable his original plan and hypotheses were, how his techniques may be improved, how nearly the finished work represents his best, and what problems remain unsolved. The pupil participates in deriving standards or criteria for evaluation, and then applies them.

Evaluation from the teacher's viewpoint includes not only this phase of pupil-participation but also that of determining whether or not the objectives of the school are being met successfully. There are several steps involved in this aspect of evaluation.[23] These are given in a skeleton outline manner.

First there is the matter of aims or objectives. These aims must have meaning to the teacher who is concerned with their achievement. The objectives are analyzed for their meanings; that is, the types of behavior which characterize "desirable" behavior according to the said objective are described. Following this, "samples" of such behavior are "collected" and this presumes that there are instances in which this behavior may be exhibited. After collecting and recording these samples the problem remains to interpret the data. This interpretation characterizes the pupil's growth.

Typical industrial arts activities lend themselves well to these evaluation procedures. From the pupil-evaluation viewpoint this is especially true. First of all the goal or problem of the pupil in industrial arts is likely to be near and clear because of its material nature and because it is likely to relate to his everyday living. The pupil may observe not only what information or skill is needed but he also has an opportunity to apply this information or skill immediately. He can then learn whether or not the information is pertinent, reliable, and adequate. He can readily discover the effectiveness of his efforts as regards work and study habits, and skills.

The teacher has available many methods and opportunities for collecting evaluation data such as: anecdotal record,[24] interviews with pupils, pupil and teacher "diaries" of progress, pencil and paper tests, rating scales, performance tests, projects made, and problems solved. This type of evaluation offers industrial arts a most worthwhile challenge.

Implications of Democracy for Method. Much has been spoken and written about the place of the school in society, the unique functions of schools in a democratic social order, and the implications of demo-

[23] Lee, J. M., "Evaluation by the Modern Secondary School Teacher." *California Journal of Education.* 11: 278-81, May, 1936.
Progressive Education Association. *Social Sensitivity,* p. 1, Bulletin No. 6, Columbus, Ohio State University, December, 1936.

[24] Progressive Education Association. *Anecdotal Records,* Bulletin No. 1, September, 1935. Ohio State University, Columbus, Ohio.

cratic concepts for school administration and classroom practices.[25] The following suggestions are presented as principles pertinent to method that have their origins in democratic ideals.

1. Intelligent cooperation. Intelligent cooperation for mutual benefit as an end has been cited as an ideal basic to American democracy. Accepting the thesis that the school should reflect, refine, and interpret this and other ideals then industrial arts, and other subject areas as well, should show regard for this ideal. For example, opportunities for cooperative effort should be offered through centering the work, in part, about a common enterprise to which many may contribute and from which they may share. Herein one may learn to respect the ideas and contributions of others which are unique, for persons have different capacities and interests.

Industrial arts programs have many potential opportunities for developing a group concern—an important aspect of intelligent cooperation. The care of tools and the use of materials, a regard for safety principles, and in general, a meeting of obligations and responsibilities characteristic of laboratory activity are commonplace instances wherein the interests of others should be considered. Good industrial arts teaching takes advantage of these and other opportunities.

Developing a group concern and achieving intelligent cooperation causes the industrial arts teacher to look beyond the classroom walls. There is the need for studying things that are socially significant; or, at least, the social implications of a problem should be considered. Hence problems as comprehensive as "Housing," or "The Conservation of Natural Resources" have aspects within the scope of industrial arts.

An emphasis upon cooperation and concern for the well-being of others should lead one to reflect seriously on practices that encourage rampant *competition* and require isolation and strictly individual effort. Similarly, detailed occupational analyses will not likely yield the type of problem or project suitable for industrial arts teaching.

2. Faith in Intelligence. Democracy places faith in the intelligence of all normal persons. The right to vote, the right to hold public office, the right to own property, and the jury system, are historical evidences of the faith democracy has placed in the intelligence of the common man.

Although normal persons can think, there are certain abilities in connection with problem solving that require practice and direction. This practice and direction the schools should offer. One significant teacher obligation, then, is to see that the pupil's "intelligence" operates, and that *thinking* becomes method of teaching and learning.

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[25] Bode, Boyd H. *Democracy as a Way of Life.* New York, The Macmillan Co., 1937.
Dewey, John. "Education and Social Change." *Social Frontier.* Vol. 3, p. 238, May, 1937.
National Education Association. *The Unique Function of Education in American Democracy.* Washington, D. C., 1937.
Progressive Education Association. *Science in General Education.* New York, D. Appleton-Century Co., 1938.

Mueh is implied for industrial arts content and method. Practiee exercises as ends in themselves, busy work, mere making, and detailed instruction that eliminates the pupil's need to think and plan are to be avoided.

Instead it will be neeessary to have the pupil partieipate in seleeting and planning much of his work, in seeuring information neeessary for projeeting the work, and in assuming responsibility for earrying his work through to sueeessful eompletion. All this tends to place ways or teehniques of doing things above outeomes in terms of a projeet. *Emphasis shifts from the project to the learner, and responsibility shifts from the teacher to the pupil.*

This prineiple means, in part, that edueational endeavor should be *intellectually challenging* rather than stimulated by extrinsie prods and motives. Industrial arts programs should eneourage partieipation in a wide variety of aetivities wherein intelligenee must operate, sueh as: reading, discussing, and experimenting.

3. Respeet for Individuality. Democraey insists that human life is the highest of values. The individual and his well-being beeomes *ends* rather than *means* of soeial organization. But, of eourse, social organization and aetion are neeessary to assure the individual's optimum growth. In a demoeracy the individual as a unique person is respeeted and there is a minimum demand for uniformity. For example, individuals may think alike on some issues and differently on others with a respeetful attitude for this differenee of opinion. Politieally speaking, Ameriean demoeraey has tolerated a minority as well as a majority and has assured the minority of all legal means for beeoming the majority.[26]

Demoeraey attempts to take advantage of the eontributions whieh an individual ean make, rather than insist that he fit into a fixed pattern. Sehools have, in many eases, attempted to bring all persons up to a set standard, have insisted that pupils think alike on issues, and have diseouraged pupils from expressing interests "outside the eourse of study." Individual differenees have been eared for, by and large, by having the rapid-learning youngster learn more of the same material, or by doing more of the same kind of aetivity.

An industrial arts program should provide opportunities that eneourage individual expressions and aeeept them for what they are worth. Of course, there is an added responsibility of aiding the pupil to improve and expand these eontributions, but improvement is a function of expression and new experienees.

To use to advantage the unique eontributions of individuals, *creative efforts* and *freedom of expression* are essential. Industrial arts is particularly fortunate, potentially, for offering these ereative opportunities. The material and eonerete nature of industrial arts are condueive to original ideas.

[26] Studebaker, J. W. "Education for Democracy." *The Nations Schools.* Vol. 17; No. 3, pp. 23-24, March, 1936.

Standards in this light take on a peculiar meaning. Rather than having all pupils attempt to attain some arbitrary standard, pupil achievement is measured in terms of the individual's capacities. And since capacities differ so will standards. *Good teaching will usually accentuate rather than modify differences of ability.*

The preceding paragraphs are summarized as follows: *thinking* should predominate as "method" of teaching and learning; school experiences should be intellectually challenging; there should be many opportunities to practice intelligent cooperation; pupils should deal with problems rather than conclusions, individual expression should not only be respected but also encouraged; any "method" used should provide for optimum pupil participation, and, industrial arts programs should be broad, representing many fields of human activity.

Learning Concepts. Other principles pertinent to method are to be found in studies of individuals—how they learn, their basic needs, and their potentialities. The following principles are cited as being applicable to industrial arts teaching.

1. Learning a directed process. An almost magical charm has been attributed to training "hand and eye;" handwork programs were long defended on the basis of mental and moral discipline. According to the "formal discipline" theory the mind was viewed as possessing certain "faculties" (memory, perception, and reasoning, for example) and the purpose of education was to train these "facultics." It was believed that training a faculty assured its proper functioning in any situation. And furthermore, one thing was about as good as another for training a faculty provided it were adequately difficult. Hence, the curriculum became very narrow and quite specific. Eventually the so-called "classics" perpetuated themselves on this theory. Mathematics was taught to develop reasoning, literature was meritorious for improving one's appreciations, science for observation, and logic for reasoning. The interest of the learner was of little significance.

This theory as interpreted in handwork programs placed emphasis upon joint and model-making. The individual was left helpless as regards applications and insight. Despite the limited and specific nature of this work, very general aims or objectives were held such as: "To develop habits of attention, interests, industry, perserverance, and patience." [27]

Even yet, some courses termed industrial arts are composed of practice exercises and the making of several projects with the belief that such things as exploration and guidance and desirable social attitudes will naturally evolve therefrom.

However, recent experimentation[28] points out that one cannot justifiably assume that this "transfer" occurs. In brief, it is necessary to practice any form of behavior that one wants to learn. If, for

[27] Salomon (Lectures of Otto Salomon). *The Theory of Educational Sloyd.* (Second Edition) Boston, Silver, Burdett and Co., 1896, 150 p.

[28] Judd, Charles H. *Educationn as Cultivation of the Higher Mental Processes.* New York, The Macmillan Co., 1936, ch. II "The Relation Between Recall and Higher Mental Processes."

example, pupils are to learn to cooperate, they will learn to do so by cooperating. If pupils are to become intelligently self-directive then as Smith[29] says:

> . . . pupils must be provided with opportunity and occasion to assume responsibility for the initiation of their own activities, for planning and developing these activities, and for securing desired or necessary information. Further, they must be encouraged to persevere, regardless of discouraging conditions or factors, to try many ways and means of solving problems, and experiment with different materials before admitting defeat. They must also be encouraged to assume an analytical approach to problems and to suspend judgment until the pertinent facts and conditions have been given due consideration. . .

Industrial arts teachers should scrutinize their programs to determine whether or not they are using methods that will yield the contributions claimed for industrial arts.

2. Learning is Creative and Continuous. Learning is an individual affair; mass learning does not take place; one cannot learn for another. In this sense all *learning is creative* since one must see meanings for himself. Inasmuch as meanings are essential to learning then an "education" is more than an accumulation of facts, skills, and habits as separate entities. However, growth does depend upon knowledges, skills, habits, and special abilities, but all of these in meaningful relationships. Learning then is not a "hanging on," "pouring in," or an "adding to" process, but rather an "internal" growth. Each new learning modifies, and is modified by, what one has previously learned. Where meanings are observed or conscious generalizations are drawn there is a continuity or "transfer" but not from the faculties or magical charms viewpoint. Thus conceived learning is a continuous process.

In some instances industrial arts teachers analyze and chart various trades for the manipulative operations involved. Then projects are chosen to include as many of these operations as possible. When a pupil makes a project he is checked as having performed the various operations. This practice may not be inherently harmful, but the assumption is frequently made that once an operation is performed it has been learned; and further that the projects collectively considered constitute a complete industrial arts program.

A teacher who is genuinely concerned about his analysis approach will not be content to analyze operations alone. He will also be concerned with analyzing all other objectives or functions of industrial arts for what they mean. Then he will find that a check mark is not an adequate way of recording pupil behavior. He will also discover that estimating pupil growth is not a simple matter of adding check marks.

[29] Smith, Robert E. "Teaching Methods Which Increase Industrial Arts Achievement." *Industrial Arts and Vocational Education.* Vol. 27, No. 5, May, 1938, p. 187.

In brief, unless the pupil performs various operations meaningfully and under different circumstances it is not a safe assumption that he has learned those operations. And unless he consciously experiences those types of expression and opportunities that are supposed to inhere in his problem or project, it is not safe to assume that learning has transcended the manipulative plane.

3. Goals. It is important that pupils work with goals. Working with goals makes for purposeful activity and precludes indifference. The industrial arts teacher is fortunate in that goals involved in industrial arts work are usually near and clear and hence meaningful to the pupil. To use to advantage the value of goals, industrial arts programs should be developed on a pupil-problem basis. Emphasis then centers upon having the pupil become sensitive to problems and of developing attitudes, skills, and understandings basic to problem solving. Subject matter or content is the "raw material" used by the pupil to solve his problems.

Some pupils may appear not to have goals insofar as school work is concerned. This may be due to the fact that the school or other environmental factors have discouraged the pupil from meeting meaningful, problematic situations. Docility is often due to being told continually what to do, how much to do, and when to do it with the test of success being measured in terms of willingness and capacity to meet these demands. Pupils can become so well accustomed to dictation that they do not enjoy freedom in their work. Such may be the case in industrial arts where the pupil faces a course of study to be covered in terms of two types of cookie cutters, a tie rack, and the wiring of three door bells. The "problem" therein is to "get through" the course.

The school, and hence industrial arts, shares in the responsibility of seeing that the pupil works with goals, that these goals continuously expand, that increasingly greater intelligence be used in achieving goals, and that goals be desirable from a human relations viewpoint.

4. Successful Achievement. Closely associated with goals is the successful achievement of purposes. Each success is a goal attained and it should make one more dynamic and eager to achieve more distant goals. Through successful experiences *thinking* and *learning* take place.

The successful achievement of purposes is essential for emotional stability. Each person has numerous impulses to be active and one gets his greatest satisfaction from achieving ends or goals that he has helped to establish. Failure to achieve success is one of the most potent factors in maladjustment. Delinquency is usually an attempt to achieve success at the risk of social approval.

This, just as the democratic concept of "faith in intelligence," implies that the learner should be encouraged to express his purposes, that he should participate in planning his work, and, that he be per-

mitted to carry his problem through to successful completion. Since all persons do not seek success in the same thing there should be a variety of opportunities for success.

Social status is one type of successful achievement. Since the individual is habitually social, his life is made richer and more meaningful when he shares in the interests and activities of others. In the industrial arts work shop the pupil has opportunities to work successfully with others and has opportunities to make and do things that give him individuality in the group. Perhaps no other school area can be more successful than industrial arts in this regard. On the school gridiron, basketball floor, and the auditorium platform a limited number of pupils achieve a group status. In a well developed industrial arts program practically everyone can do things that are respected by school companions, parents, and anyone else who appreciates craftsmanship. This type of achieving is not limited to the duration of the pupil's school attendance, but may be carried on indefinitely.

5. Interest. Dewey has cited two aspects of interest, namely: a *concern for what is going to happen,* and *a tendency to act to assure desired outcomes.* Accepting this description it is apparent that what has been said of goals applies equally well to interest. There are several items pertaining to interest that deserve direct mentioning.

One point of significance is the fact that interest is a function of experience; what one is interested in depends upon his past experience. Hence, a person's interests are potentially as comprehensive as the activities carried on in his environment. The school environment should therefore be rich and stimulating. The industrial arts work shop should provide an abundance of opportunities for pupils to have new experiences, and hence develop new interests. It is true that a pupil who knows little or nothing about some industrial arts areas, such as plastics, is not likely to be interested in it. However, skillful teachers have pupils approach unfamiliar areas intelligently. This is not equivalent to saying that all pupils should be routed through a series of units. Rather, it is implied that the pupil should be lead to see a purpose in his work, for example, an exploratory purpose, and that the pupil should be concerned with learning whether or not he likes the above-mentioned plastics. Pupils under these conditions work with interest.

An industrial arts teacher may secure interest by many diverse procedures. The fear of failure, low grades, embarrassment before classmates and similar prods may cause a pupil to become interested in reading an assignment, in bringing in wood samples, or in visiting a department store in connection with making an imposed project. The same pupil may read many books, he may collect many materials, he may visit many places, and he may interview many persons if, for example, he is building a model airplane that he wants to enter in a meet, if he wants to learn about the city water system, or if he

wants to know how steel is made. In both procedures interest is present but certainly the quality or scope is decidedly different—and so are the learning values.

Experienced teachers know that learning under compulsion either by punishment or by rewards, tends to be verbal, without definite meaning, and hence ineffective. This seems reasonable when the fact is considered that when one is absorbed in learning something for the sake of passing an examination, or for the sake of being able to display a skill "on request," he is not encouraged to seek meanings or applications during the "drill."

It is not enough to have pupils "smilingly interested" in what they are doing. In fact, one's countenance may be an indication of deceit rather than interest. The pupil who identifies what he is doing with an end to be achieved is usually willing to forego many unpleasant difficulties that he would not otherwise bear unless he were urged to do so by an external force.

Returning to the above concept of interest, namely, a concern for what is going to happen and a tendency to act to assure desired outcomes, it is important to note that goals are involved and these goals constitute the difference between an interest and a *whim.* A person who acts voluntarily on the basis of whims is one who holds no goal or purpose for the activity involved.

An interest in itself is neither good nor bad; it is the goal that must be characterized. To direct or expand interests is all one with changing the pupils' goals.

Summary. By way of summary these generalizations are stated. A teacher can spend a large amount of his time revising and perhaps perfecting one detail of his method without effecting any significant improvement in his teaching. One example may be the making of templets. It would be possible to make templets so accurate and so "fool proof" that every pupil would finish the course with a well made project. One would question the advisability of perfecting or using templets to that extent. To do so would be a definite regression in teaching.

Where one has a limited quantity of materials to teach, method is not a major problem. An enriched industrial arts program requires the teacher to have some knowledge of, and ability to use, many methods.

A problem approach to industrial arts teaching has been suggested recurrently but this makes for a greater need of specific and individual guidance.

Every detail in the shop has its implications for methods. For example, a dirty, ill-kept shop is not conducive to good work. Industry has recognized this fact, many school people have not. Cleanliness, adequate light, minimum machine noise, proper ventilation, adequate space, cheerful walls, resilient floors, and safety precautions are among those physical aspects of the shop which affect learning.

An industrial arts shop should be a pleasant place, a place where pupils are eager to go to do things, a place where pupils can "study" and "think" as well as manipulate.

E. INDUSTRIAL ARTS TEACHING DEVICES

An industrial arts teacher will have need for many teaching devices in carrying on an enriched program. The following pages describe several devices and facilities that have been found helpful; these are discussed from an industrial arts viewpoint.

Library facilities; references and texts
Experiments
The building and use of miniatures
Working models
Displays
Charts
Exhibits
Trips and visits
Films and slides
Pupil organization
Museums
Instruction sheets

1. Library Facilities. An industrial arts work shop is a place for "thinking" as well as manipulating and for planning as well as executing. No industrial arts laboratory is considered complete without a library of references relating to the various areas represented. This library should include not only materials relating to projects, but also—and predominantly so—titles dealing with manufacturing methods and conditions, with technical information that may be helpful in planning work and solving problems, with arts and crafts information, and with titles dealing with material cultures.

The literature in the field continues to grow very rapidly. Practically every significant industrial invention, discovery, and process may be found discussed in a non-technical manner. The superior type of magazine carries articles concerning industries, industrial problems, and occupational information. Books on the cultural aspects of industry are in abundance. There are many booklets supplied by various industries that may be had for the asking. The chief objection to this type of literature has been the advertising involved. However, many companies have worthwhile publications that contain a very minimum of advertising and in some instances the company name is omitted.

The library should be located in a quiet, clean place wherever possible. The drawing and planning room is usually an ideal location. Allocating funds for the industrial arts library should not be an after-thought, but one of the first items for consideration. A good

library is basic to the type of industrial arts program outlined on preceding pages.

2. Experiments. Is a piece of cloth wool or shoddy? What are the relative wearing characteristics of various textiles, leathers, and leather substitutes? Is a "solid" walnut table top superior to a laminated one? These questions are suggestive of the types of information that may be profitably sought after in the industrial arts testing laboratory. Expensive equipment is not necessary or even desirable since it is to be hoped that the pupil will be led to test commercial products later for his own home where ordinary household appliances will have to serve as the "apparatus." An illustration is the testing of the moisture content of cabinet woods where the only apparatus required is a set of scales and the oven of the kitchen stove.

There are many other significant experiments dealing directly with industrial arts work which may be carried out. There are experiments involving the use of electricity and radio. Paints, varnishes, and lacquers furnish an almost inexhaustable field for the amateur experimenter. It was a Pennsylvania industrial arts teacher who with the help of his students a few years ago invented a luminous paint which is energized by an ordinary electric light. The moon, stars, and nursery rhyme characters painted with this paint glow in the children's room long after the light is turned out each night.

A bureau of standards type of testing laboratory with home-made equipment might be set up in any industrial arts shop where not only the students running the tests would profit from the findings but the buying habits of the entire school population might be changed and the purchasing power of the entire community raised. In addition to the home-made equipment a microscope should be part of the regular equipment of every industrial arts department. The inclusion of some pieces of scientific equipment in the testing laboratory and even the laboratory itself should not be construed to mean that the industrial arts department is trying to absorb the science department or that it is trying to usurp science teaching materials. These two departments should be thought of as being mutually helpful and the closer the relationship the greater the opportunities for teaching and learning.

If the product of this type of testing and experimenting with everyday articles is pupils with an inquisitive attitude toward values, and pupils with sufficient knowledge to distinguish between that which glitters and that which is pure the objective of this technique will have been fulfilled.

3. The Building and Use of Miniatures. There are many mining and manufacturing situations and processes which lend themselves to reproduction in miniature. Examples are: cross sections of anthracite and bituminous coal mines, coal breakers and washers, blast furnaces, rolling mills, and Bessemer converters. There are

also sections of model houses showing interior construction and sections of an Indian pueblo showing their bee-hive construction.

Some commercial systems are so far-flung and so situated that the actual observation is out of the question for most pupils and the knowledge obtained by those who are able to contact the system at various points is so fragmentary that it has little meaning. An electric transmission system may be used as an example. Practically everyone comes in direct contact with an electric transmission system but very few persons have a clear conception of its workings. Many homes use electric light, power, and heat; all who can see, recognize high-voltage power transmission lines and transformers, and most pupils at one time or another visit either a steam, or hydroelectric generating plant. In spite of these observations, the average person is unable to piece the fragments together and see true relationships and understand where each element fits into the total picture. Here is one of the many places where a miniature actually helps one to understand basic relationships better than contact with the system itself. A similar situation is presented by a city water supply system. Again a miniature would show basic elements as well as operating features as a complete and understandable whole, while actual contacts with the system of various points without previous orientation leaves one with bits of information that have little real meaning. In most systems of this kind a miniature will serve to orient the pupil's thinking and to give him perspective. An actual visit to parts of the system such as the hydroelectric plant or the city pumping station, will then be a significant experience for him.

Hydraulic engineers have built model dams, locks, et cetera, for years in an attempt to gain specific engineering data relative to the characteristics of water under varying conditions.

4. Working Models of Various Types. Practically all that was said about miniatures could be repeated here. This is especially true when one considers the values which may accrue to the pupil from modelmaking. The chief difference between the two lies in the type of model used.

The cutaway engines and chassis that one sees at an automobile show may be suggestive of the types of working models that could be built for instructional purposes. There is another and perhaps more important element to be considered here. That is the possibility of modelmaking as a hobby for many pupils. The number, variety, and editorial rank accorded to model-makers magazines is one criterion for forming an opinion relative to the importance and scope of modelmaking in the country today.

There are doubtless many more flying models of airplanes than there are actual airplanes in the United States as well as in other countries. What boy in the secondary school is not interested in building midget gasoline engines to power model airplanes and model boats?

The industrial arts teacher who overlooks this field is neglecting a natural interest in boys as well as grown-ups. Here he has a chance to sow the seeds of a hobby that is much more healthful than the sedentary ones, such as stamp collecting, and at the same time one which will carry over into adult life with added interest and satisfaction. From a practical and monetary point of view it should be pointed out here that seaplane hulls and pontoons are first built in miniature and run through tests before the life-sized ones are made. The aero-dynamic characteristics of proposed airplanes are charted from small scale models in wind tunnels before the "ship" leaves the drawing board. New York's World Fair has been observed by more people in model form than will perhaps see the actual fair.

5. Displays. There are a great many types of displays that have special significance for industrial arts teaching. One type includes manufacturing and mechanical processes as well as manufactured products. These are sometimes obtainable free from various manufacturing companies. Examples are: The Steps in Forging a Claw Hammer, How Files Are Made, The Production of Handsaws, Woodworking Abrasives, and Carborundum and Its Uses. Some companies make displays free of advertising matter and sell them to schools at cost prices. An example is: "Commercial Woods of the United States" prepared by the National Lumber Manufacturers Association, Washington, D. C.

Another type of display shows the various raw materials that are used in making some common article such as an automobile tire. Some displays begin with the raw materials and show the processes they go through until the finished product emerges. Many oil companies and paper mills will furnish displays of this type.

There are the more expensive displays which are loaned to schools for a specified length of time. Frequently, there are special displays such as that of the American Walnut Manufacturers Association which have unusual significance from the industrial arts point of view which are exhibited only at the larger furniture and department stores. Displays of this sort make for worthwhile visits.

A second major group of displays are those made by the pupils themselves. These pupil-made displays may serve to illustrate various types of material used in the shop such as nails, screws, woods, and finishes.

Each type of display has its particular use; it should be used at its appropriate time and then stored until needed again and should not be left lying around the shop until the next year. Permanent displays are usually unnoticed by the pupils.

6. Charts. Wall charts are certainly not new in the field of industrial arts teaching. Today, however, they are more numerous and better prepared than previously. Practically every manufacturing establishment whose products are used in school shops or laboratories furnishes charts covering their use or their manufacture. Examples

are: Coated Abrasives Chart furnished by Behr Manning Co., Troy, New York; Lecture Course on Coated Abrasives furnished by Behr Manning Co.; A File for Every Purpose furnished by the Nicholson File Co., Providence, R. I.; Architectural and Engineering Drawing Symbols furnished by Fredrick Post Co., Chicago, Ill.; Decimal Equivalents and Tap Drill Sizes furnished by Whiteman and Barnes, Detroit, Michigan. Some charts contain pertinent drawing room and shop information such as decimal equivalents. An examination of the current professional magazines in the field will serve to verify this statement as well as to furnish the teacher with a list of charts which may be obtained free of charge.[30]

There is a second kind of chart, which is, perhaps, more significant from the industrial arts point of view. This is the chart made by the pupils. These charts may contain such information as the use of hand tools or they may display raw materials such as cotton, flax, or woods. A chart made by pupils may show the coal tar derivatives of a lump of coal, or the historical development of the graphic arts. There is practically no limit to the number of educationally significant charts that may be made and used by the pupils. It might be suggested that charts which are hung on the wall in September and remain until the next June lose their effectiveness. The deposit of dust combined with wear and tear makes them actual eyesores. They should be filed away in a storage room, much like books are cataloged in a library and should be used when their information is pertinent to the work at hand.

7. Exhibits. Exhibits of various kinds are included in all well-developed public relation's programs. These exhibits are of two general types; those held in the school and those held elsewhere.

Most schools have well located and adequately lighted exhibit cases. If the industrial arts department does not have exhibit space of its own the teacher should try to arrange a schedule whereby the department could use other available space at definite times. To be effective, exhibits must be neatly and artistically arranged. Cards telling about the exhibit and the exhibitors should be uniform in character. Printed cards are usually superior to other kinds. Most exhibits should not last over a week or two at the most. Exhibit cases which are never changed are usually passed unnoticed. On the other hand, where exhibits are changed according to some regular schedule pupils form the habit of watching for the new exhibit.

The older type of exhibit was used as a sort of a mile post on the way to woodworking proficiency. It was usually held near the end of the school year. The teacher and the pupils spent almost the entire time previous to the exhibit in getting ready for one grand splurge. The gymnasium, library, or some similar space was filled with furniture and the public was invited to view the year's accom-

[30] Hughes, Wayne P. "Teaching Aids." *Industrial Arts and Vocational Education.* 26:9::274:276, September, 1937. The author lists sources of materials obtainable from various companies. The list is appropriate for woods particularly.

plishments. It never seemed to occur to the exhibitors that furniture should be exhibited in smaller rooms where the pieces would have natural surroundings. Those in charge seemed little perturbed by the fact that fireside chairs and boudoir lamps were exhibited side by side.

Happily this type of exhibit is rapidly passing and the open shop of today finds the pupils busily engaged in actual doing. Processes are much more interesting to the average persons than are the finished products, the graphic arts, the foundry, the woods, the metals; and the electric area are very interesting places for interested patrons to see how things are made. And in addition to learning how pottery is glazed and fired they see their own sons and daughters as well as their neighbors' children at work.

Exhibits outside of the school are usually held in stores, store windows, and at the county or state fairs. The same general advice that is offered above for school exhibits applies here. Make the exhibit tell a story if possible. Animated exhibits attract more attention than still ones. Best results are obtained regardless of exhibit location when the pupils are the center of interest rather than some finished product.

8. Trips and Visits. The monastic character of the school is gradually changing. Dewey's contention that "Education is life," has influenced to a great extent this changed attitude toward the relationship existing between the school and community. One way in which teachers can help to foster a better understanding between the school and community is through planned excursions outside the classroom.[31]

An excursion by a school group may be a worthwhile educational activity or it may be only a pleasant interlude to break the monotony of class procedure. The success of a trip outside the school building depends upon careful preliminary planning and subsequent evaluation. What will we see? What shall we look for?—are student questions that can only be answered before the visit by a guide who himself has been over the ground. If an intelligent preview is given, the average group of alert youngsters can be depended upon to furnish the material for a lively and illuminating discussion after returning from a well-conducted tour.

Almost all schools are conveniently located near places of significant educational interest. In highly industrialized sections of the country the opportunities for visits to mills and factories are, of course, more numerous than in some urban and rural sections. However, the values derived from an educational trip cannot always be measured by the size or impressiveness of the plant one visits. Many worthwhile excursions can be made to garages and shops in the neighborhood of the school if opportunities do not exist for visiting more basic industries. With careful and intelligent planning such visits can be

[31] Pennsylvania Department of Public Instruction. *Expanding the Classroom.* Harrisburg, Pa., 1938.

made to yield educational values and tend to breakdown the barrier between the school and the community.

Another place where many industrial products can be seen is in a modern store, particularly a department store. Here products of metal, wood, clay, leather, rubber, textile, and other materials may be seen in great profusion. True most people frequently see these items but not in the same light in which they would view them on a visit with an industrial arts teacher.

Not being under compulsion to buy, students of industrial arts could have the help of teachers and salesmen to study design, color combinations, workmanship, and values. Such cooperation on the part of the store should not be difficult to obtain if the management is convinced of the value of the undertaking.

Other visits may be taken to the offices of doctors and dentists, to examine X-ray equipment, to newspaper offices and printing establishments, to the projection rooms of motion picture theatres to study sound and picture projection, to foundries, to telephone and telegraph offices, to power houses and electric sub-stations, and to the workshops of local potters and weavers.

Regardless of where it is made, if the visitation has been well planned and conducted so that the group is invited to come again, then the activity has probably served the dual purpose of furthering the education of youth and cementing the tie between the school and the community.

9. Slides and Films. That pictures are effective visual aids for education is indicated by the liberal use of illustrated material in school textbooks. Excellent as these pictures usually are, it is often desirable to have a group examine illustrations in supplementary texts or reference books. This is often difficult when a limited number of copies of a particular book are at hand. Relatively inexpensive projectors are obtainable whereby pictures from books, magazines, or ordinary photographs may be thrown on a screen and shown to large groups. Other types of projectors use glass or film slides. The use of either type of projector permits the class to view pictures many times larger than the illustrations found in books. Besides being more convenient than passing books or pictures around the class, the large size projected-image enables the teacher to point out and emphasize particular parts of a picture without the likelihood of anyone mistaking to which part it referred.

Slides are useful when it is necessary to show visual material in the form of pictures, charts, diagrams, graphs or sketches to a group. At times, however, it is an advantage to show a series of pictures of the same subject or to depict a process where it is necessary to watch each operation to gain a clear understanding of the procedure. In such cases motion pictures are superior to slides. In some instances where it is desired to show how manipulative processes are carried out the use of "slow motion" pictures can be used to virtually stop

the hands of the worker. Slow motion pictures are also valuable when studying industrial processes that are carried out at extremely high speeds.

Another use for motion pictures is to show industrial activity that is too distant for class excursions. Among the chief objections to class visits are those of time and expense. Through the aid of motion pictures both of these objections can be satisfactorily met. This does not imply that school journeys should be abandoned. It means, however, that the more distant industrial plants and those requiring a great deal of time to visit such as automobile factories and steel mills may be visited vicariously while smaller local industries are studied at first-hand.

Those obtainable from well-known industrial firms may usually be had for the cost of transporting the film. For further information and lists of available films the reader is referred to publications on visual aids in education.

10. Pupil Organization. Success in industrial arts teaching depends to a very great extent upon the teacher's ability to organize his work, his instructional materials, and his classes upon an efficient basis. The present-day democratic conception of the function of general education implies democratic procedures in classrooms and laboratories. There are few school situations which provide better opportunities for education toward significant democratic ends than are provided in the industrial arts area.

Professional magazines during the past decade have offered many excellent suggestions for pupil organizations[32] in industrial arts classes. Most of these schemes have certain designated officers—shop superintendent, foremen, safety engineers, tool keepers, and the like—who serve at each post for a week or some other allotted time and then move on to another position. It will be noted that the student has a chance to serve in each capacity during the year. In a democratic society good citizens are alternately leaders and followers. The emphasis in the workshop is on developing rather than selecting leaders. The chief criterion for judging the efficiency of the officer is that of cooperation or the ability to get along with his group. In fact one of the chief benefits which might result from an organization is the acquiring of the "give and take" attitude which is so essential in later life. It might also be pointed out that practically all industry is organized along similar lines and that the trend today is toward the participation in policy making by the most obscure worker.

Good pupil organizations are not inaugurated with the idea that larger classes than the instructor could otherwise handle will thus be cared for. Neither are they set up in such a way that accident hazards result from having "the blind lead the blind" where the demonstration or use of power equipment is the lot of some hapless

[32] Carlsen, F. A. "Pupil Foreman Type of Organization as a Teaching Device in the General Shop." *Industrial Education Magazine.* 1934. p. 64. Manual Arts Press, Peoria, Ill.

"foreman." Authority to use a certain machine may be delegated by a badge or a title, but *ability* to use it cannot be so delegated. Nor should a title be used as a scheme to inveigle the pupil into doing janitorial work. There seems to be no more reason why a pupil should sweep the shop floor than that he should sweep the library floor.

A "yardstick" should be applied to the various offices or "chairs" in the proposed organization before it is put into effect. Some of the questions that should be asked about an office are: Can the average pupil safely perform the duties required? Will the pupil learn anything of significance at this particular post or will he be a mere flunkey? Is the time required to perform the duties of an office disproportionate to the benefits accruing? Is the office likely to instill anti-social habits in either the group or the officers? Is the whole organization run for the benefit of the students through additional opportunities for the practice of democratic behavior, or does the "tail wag the dog?"

A pupil organization should be thought of merely as one of a number of teaching devices that may be used very advantageously under certain circumstances and should not be used at all under other conditions. The outcomes are usually more important than the methods used. If the average student has to spend the greater part of his allotted shop period trying to make some ill-conceived organization function and finds little or no time available to be devoted to the problem at hand it is probable that some other method could be used with better results.

If each "office" is carefully scrutinized before it is included in the organization and if it satisfactorily passes the hurdles listed above and if the teacher thinks of it as one more opportunity for teaching desirable citizenship traits, then and only then can this whole scheme be legitimately used in industrial arts teaching.

A suggestion might be made concerning the inaugurating of pupil organizations. Few organizations of this kind which sprang into existence full-grown have been successful. The teacher who visits a school where such an organization seems to be functioning well and is tempted to go home and inaugurate a similar system can have little hope for success. The same applies to the teacher who reads a glowing account of a pupil-personnel organization in another school and attempts to transfer it *in toto* to his own school. Such an organization must be developed over a period of time. And since each school situation is unique modifications should be made to compensate for these differences.

11. Museums. Museums are themselves educational institutions and as such are usually willing to cooperate with the schools. The term museum means to many people a building for the display of pictures and statuary, or a place wherein to deposit relics of the past. Museums of this kind have been of great service to the schools.

However, during recent years another type of museum has been receiving a great deal of attention. In these newer museums are to be found displayed industrial products, raw materials, and exhibits showing the historical evolution of products in common use. Coal mines, oil refineries, rolling mills, and other industries are shown in miniature and can be made to operate when the visitor presses a button—activity being the keynote of these exhibits.

Excellent examples of these may be seen at the Museum of Science and Industry at Chicago, the Commercial Museum of Philadelphia, and the Museum of Science and Industry at New York. The State Museum at Harrisburg is rich in industrial lore peculiar to Pennsylvania.

True the better industrial museums are not always near enough to be available for visits by industrial arts classes. Nevertheless teachers of industrial arts can and should visit these museums as a source for ideas to vitalize their own school programs. While it is true that most schools do not possess the necessary resources or talent for duplicating large metropolitan museums of the type described, yet many of the things done in museums of industry can be duplicated in modified form in school shops. The building of models and displays by industrial arts pupils would provide worthwhile educational activity besides contributing something toward a permanent industrial museum within the school.

12. Instruction Sheets and Their Use. When an industrial arts teacher attempts to carry on a diversified program and is sincere about caring for individual differences, he will find a variety of teaching devices of utmost importance. Instruction Sheets is one such device. There are manipulative operations and considerable information related to industrial processes that many industrial arts pupils will have need to contact. Quite often the desired information is not in available or convenient form for teaching and learning purposes. If the teacher has time to relate the desired information, it may reduce the status of the teacher to a walking encyclopedia and it will also make it unnecessary for the pupil to learn how to find and how to interpret information. If the teacher demonstrates an operation it may require reviewing by the pupil. An instruction sheet makes this review possible.

The use of instruction sheets should never be carried to a point where more effective methods of instruction are excluded. It is not intended that the instruction sheet displace the instructor. They should be used whenever they make it possible for the pupil to do better work and have more satisfying experiences.

The following is a description of popular types of instruction sheets:

13. The Operation Sheet. The demonstration method of teaching habits and skills is doubtless as old as the human race. If it is true

that one learns to do by doing, it is equally true that one learns to perform a manipulative operation by watching someone else perform it. It is also a fact that pupils are able to learn a new skill much more rapidly if the person who is teaching the skill stops to analyze each step as he performs it, draws an occasional diagram to show the "why" and "how" of some particular part that is not clear, tells about each operation briefly as it is performed, uses language that the learners understand, and finally leaves his drawings and notes on the blackboard or elsewhere where they may be referred to again by the student to refresh his memory or to clear up some particular point after the exact words and demonstration of the teacher have been forgotten.

The above paragraph actually describes a good operation sheet and the things that should be included in it, as well as the manner in which it should be used. Operation sheets are designed to supplement the teacher's demonstration and not to take the place of it.

The operation sheet gives definite instruction in the performance of one operation unit which is an essential element in many jobs; for example, "How to Make a Hand Grooved Seam:" [33]

14. The Information Sheet. In a typical shop demonstration the teacher may use or refer to such things as: a one-inch No. 10 flat head wood screw, a No. 20 wire drill, a 6d finishing nail, a piece of No. 000 sandpaper, a No. 12 wire, and many other common materials. He probably has samples of all materials used or referred to, which are passed around for inspection during the demonstration. At the end of the demonstration the student needs the answers to many questions. What is the approximate fractional size in inches of a No. 20 wire drill? Is a No. 20 drill larger or smaller than a No. 30 drill? What does a No. 10 designate on a box of wood screws? Are screw sizes and wire sizes comparable? What does 6d mean when it is translated into inches? Information sheets are designed to present this type and many other types of information which relates to shop and manufacturing terms.

The information sheet treats items of information which are of value and interest to the student. The information may be of a general nature relating to the unit as a whole, such as "How Steel Is Made," or it may be specific, relating to an operation such as "How to Select Hacksaw Blades." [34]

15. Assignment Sheets. Assignment sheets have been used successfully for such a long time by practically all teachers that they need little explanation. They are used in the study of specific problems and are designed to direct the reading, observation, and the thoughts of the students. The publishers of most of the newer

[33] Coover, S. L. *Instruction Units in General Metal Work.* p. 18. State Teachers College, California, Pennsylvania, 1938.

[34] The instruction sheets mentioned on this page as well as other starred sheets will be found in the Appendix of this bulletin.

mechanical drawing books for secondary schools also publish a series of assignment or work sheets to be used with the texts.

16. The Job Sheet. The job sheet furnishes the pupil with instructions for doing a single job, such as "How to Make Fire Tongs." The job sheet may combine essential elements of operation, information, and assignment sheets. The job to be done is the integrating factor. Several useful and desirable operations may be brought together in one interesting and significant project. The job sheets on "How to Make Fire Tongs" may be used as an illustration. Here the operations of swaging, raising, and peening are combined with other simpler metalworking processes and practice in the entire group is presented in making a single useful project. Acceptable, efficient, and safe ways of doing thousands of jobs are available in job sheet form for hobbyists and amateur mechanics.

17. The Job Planning Sheet. The job planning sheet, as the name implies, is one on which the job is planned by the pupil with the advice and counsel of the teacher. The pupil lists the steps of procedure, the names of various information and operation sheets which contribute directly to the solution of the problem, the tools to be used, and the bill of material. He then sketches a working plan of the project he wants to make.

This type of sheet compels him to "think his problem through" before beginning it. This makes for a good learning situation and it saves spoiled materials and disappointment by leading the pupil to discover for himself what he may or may not be.

Information Sheet

INDUSTRIAL ARTS DEPARTMENT

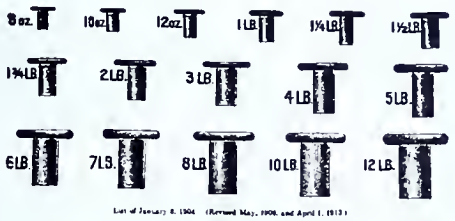
State Teachers College
California, Penna.

Cuts Furnished By Courtesy of the American Steel and Wire Co.

General Metal Information Sheet
Wire and Rivets

TINNERS' RIVETS AND WIRE

TINNERS' RIVETS



List of January 8, 1904. (Revised May, 1906, and April 1, 1913.)

Sizes of Wire

American Steel & Wire Co.'s Steel Wire Gauge

American Steel & Wire Company's STEEL WIRE GAUGE No.	Sizes of Wire: Common Fractions	Sizes of Wire: Decimally	Weight One Mile Pounds	Pounds per Foot	Feet to Pound
1		.2830	1128.0	.2136	4.681
	9/32	.28125	1114.0	.211	
2		.2625	970.4	.1838	5.441
	¼	.250	880.2	.1667	
3		.2437	836.4	.1584	6.313
4		.2253	714.8	.1354	7.386
	7/32	.21875	673.9	.1276	
5		.2070	603.4	.1143	8.750
6		.1920	519.2	.0983	10.17
	3/16	.1875	495.1	.0937	
7		.1770	441.2	.0835	11.97
8		.1620	369.6	.070	14.29
	5/32	.15625	343.8	.0651	
9		.1483	309.7	.0586	17.05
10		.1350	256.7	.0486	20.57
	1/8	.1250	220.0	.0416	
11		.1205	204.5	.0387	25.82
12		.1055	156.7	.0296	33.69
	3/32	.09375	123.8	.0234	
13		.0915	117.9	.0223	44.78
14		.0800	90.13	.0170	58.58
15		.0720	73.01	.0138	72.32
16	1/16	.0625	55.0	.0104	95.98
17		.0540	41.07	.0077	128.6
18		0475	31.77	.006	166.2
19		0410	23.67	.0044	223.0
20		.0348	17.05	.0032	309.6

RIVETS

The size of tinners' rivets is determined by the weight per thousand; that is, an 8 oz. rivet means that 1000 of such rivets weigh 8 oz.; or a 1 lb. rivet means that 1000 of such rivets weigh 1 lb.

The most commonly used rivets are the 1 lb. and 2 lb. rivets. The 1 lb. rivet is approximately 7-64 in. in diameter, 13-64 in. in length, and requires a hole 1-8 in. in diameter. The 2 lb. rivet is 9-64 in. in diameter, 17-64 in. in length, and requires a hole 5-32 in. in diameter.

The illustration above shows the actual size of tinners' rivets. Rivet holes are usually punched and not drilled.

WIRE

Annealed wire, tinned, coppered, or galvanized is usually used for sheet-metal work in the school shop. Wire is used to reinforce or strengthen the objects and also to provide safe edges on objects, such as tin cups. Wire is tinned so that it may be more easily soldered, and it is annealed so that it may be more easily formed to any desired shape.

Wire is measured by the American Steel and Wire Co.'s Wire Gauge. The actual sizes of the various gauges are shown at the left.

The most commonly used gauges of wire for sheet-metal work in the school shop are: numbers 8 and 9 for large pails, ash cans, garbage cans, etc.; number 12 for tin cups and small pails; number 14 for small objects such as biscuit cutters and cookie cutters.

Operation Sheet

INDUSTRIAL ARTS DEPARTMENT

State Teachers College
California, Penna.

Cuts Furnished by
Courtesy of the
Cleveland Twist Drill Co.
Cleveland, Ohio

General Metal
Operation Sheet
Twist Drill

HOW TO GRIND A TWIST DRILL

Sheet-B

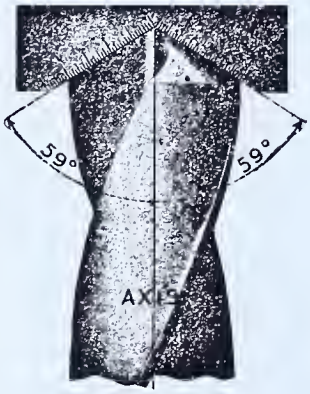


Fig. 6

Fig. 7

Fig. 8

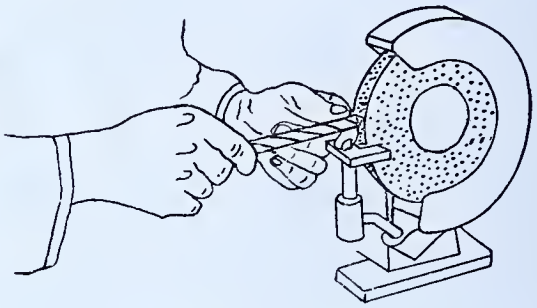


Fig. 5

Fig. 5 shows the correct way to hold a drill against the wheel at the beginning of the grinding operation. Note carefully that the cutting lip is held parallel with the floor and that the right hand is held lower than the point of the drill.

The Grinding Operation

(Practice the following operations before turning on the power)

1. Grasp the drill with the left hand near the point and with the right hand on the shank. Rest the left hand on the tool rest and hold the right elbow firmly against your body.

2. THE COMPLETE DRILL POINT IS GENERATED BY A SIMPLE TWIST OF THE RIGHT WRIST. With the drill point touching the stone and the cutting lip parallel with the floor twist the right wrist clockwise through 45 degrees. Note that the drill shank moves slightly downward as the wrist twists. This gives the 12 degrees lip clearance. Do not let the drill revolve in the right hand.

3. If the drill is twisted too far (more than 45 degrees) the second cutting lip will be ruined.

4. Take one sharp cut off each side, then cool the drill in water.

5. Grind each cutting lip atlernately with uniform cuts until the edges are sharp and until the margins are full.

6. Figs. 6 and 7 show drill point gauges which are used to check the lengths of the lips and the angle that they make with the axis. The drill lips should make 59 degrees witb the axis and both must be exactly tbe same length.

7. Fig. 8, shows a properly ground drill point. Tbe angle between a cutting lip and the dead center should be between 120 and 135 degrees. If this angle is less than 120 degrees, there will be insufficient lip clearance; if the angle is more than 135 degrees there will be too great lip clearance.

Operation Sheet

INDUSTRIAL ARTS DEPARTMENT

State Teachers College
California, Penna.

Cuts Furnished by
Courtesy of the
Cleveland Twist Drill Co.
Cleveland, Ohio

General Metal
Operation Sheet
Twist Drill

HOW TO GRIND A TWIST DRILL

Sheet-A

Fig. 1

LIP CLEARANCE is the relief which is given to the cutting edges of a drill in order to allow them to enter the metal.

Fig.1, shows a drill without any lip clearance Note that the "heel" shown at "S" is the same height as the cutting lip. This drill cannot cut because surface "S" will prevent the cutting edge from hiting into the metal.

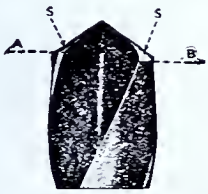


Fig. 2

Fig.2, shows a drill with proper lip clearance where the surface "S" has been ground away back of the cutting lips (this grinding away, is called giving the drill relief) so that the drill can penetrate the metal. Note how much lower the heel line "B" is than the cutting lip line "A" The difference is the measure of the clearance.

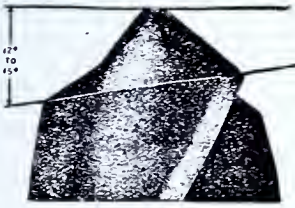


Fig. 3

Fig 3., shows the proper way to grind the surface back of the cutting lip. The angle illustrated is the angle at the circumference of the drill. The heel (the surface back of the cutting lip) should be ground away from the cutting lip at an angle of about twelve degrees.

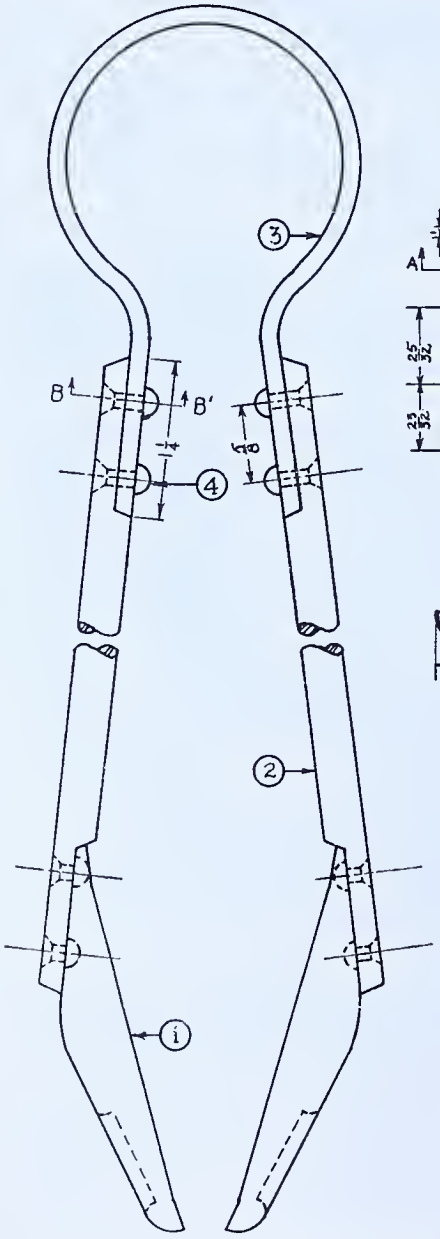
Fig. 4

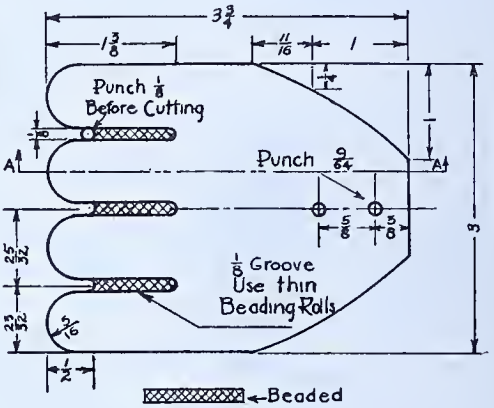
Fig. 4, shows the results of giving the drill too much lip clearance--- the edges of the cutting lips have broken down because of insufficient support.

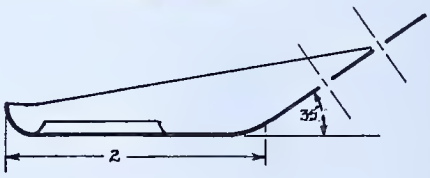
Before attempting the grinding operation take a 1 inch drill that has been properly ground and study it carefully. Note the lip clearance and the position of the dead center in relation to the cutting lips. Note also that the drill point (Fig.7) is not flat hut conical in shape.

Job Sheet

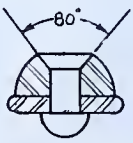
FIRE TONGS







Section on A-A'



Section on B-B'

Bill of Material				
No	Name	Size	Req'd	Material
1	Clam	3x3 3/4	2	*22 guage steel
2	Handles	12 1/2 x 3/16	2	C.R.S.
3	Spring	1/8 x 1/2 x 12	1	Strap Iron
4	Rivets	1/8 x 3/8	8	R.H.

Job Planning

State Teachers College - California, Pennsylvania
Industrial Arts Department

FIRE TONGS

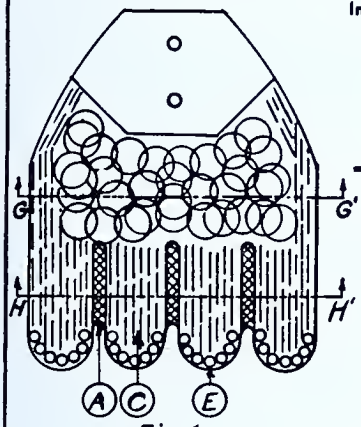


Fig. 1

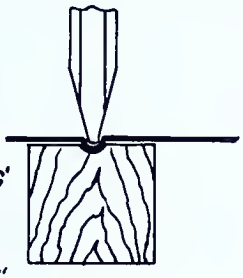


Fig. 2

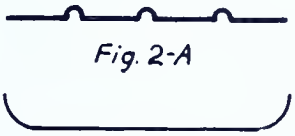


Fig. 2-A

Section on G-G'
Fig. 3


Section on H-H'
Fig. 4

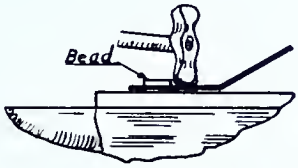


Fig. 5


Fig. 6

Legend

- Raising Hammer
- Crosspean Hammer
- Spotting Hammer
- Beaded

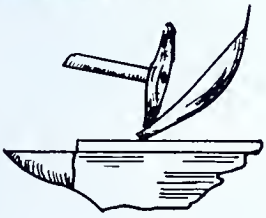


Fig. 7

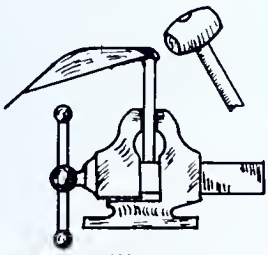


Fig. 8

HOW TO SHAPE THE HANDS

1. Lay out and make hands. See assembly sheet.
2. Bead A, Fig. I, on a beading machine. If one is not available, this operation may be performed by using a rounded chisel and a block of wood as illustrated in Fig. 2. Fig. 2-A shows a cross section after the beading operation has been completed.
3. Hold the hand on the anvil with the beads up and strike the palm of the hand with a raising hammer. This will cause the metal to expand and the sides of the hand to raise gradually taking the shape of cross section on G-G" (Fig. 3)
4. Striking the center of the fingers, Area C,(Fig.I) with a cross peen hammer will cause the metal to expand and round out fingers. See Fig. 5 and section H-H' (Fig. 4)
   CAUTIONS: In cross peening be careful not to flatten out the beads. The edges of the hand should never be hit with a hammer because the metal will expand and leave a ragged edge.
5. The sides are rounded with a cross peen hammer by tilting the hand on its side. Fig. 6.
6. A spotting hammer is used to round the tips of the fingers,Area E, Fig. 1. Proceed as in Fig. 7.
7. The finger nails are formed by placing the fingers over a 1/2" dia. rod of C.R.S. held in a vise. Tap the fingers lightly with a mallet as in Fig. 8.

State Teachers College - California, Pennsylvania
Industrial Arts Department

FIRE TONGS

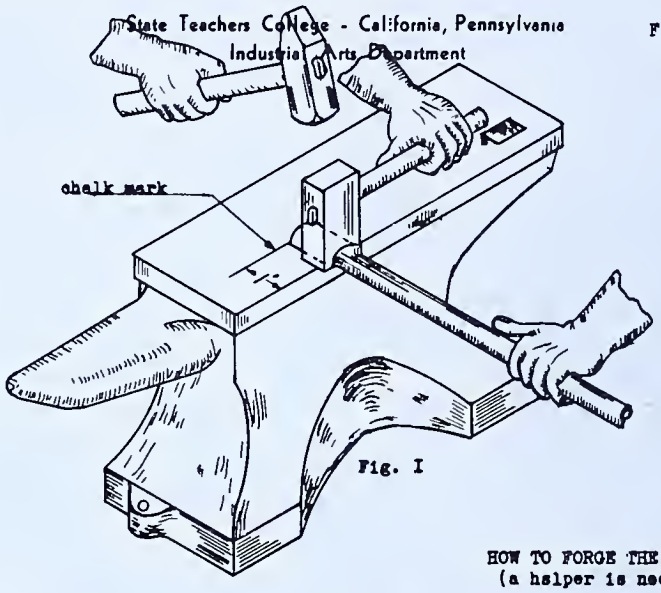


Fig. I

HOW TO FORGE THE ARMS
(a helper is needed)

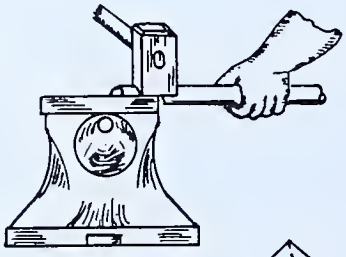


Fig. 2

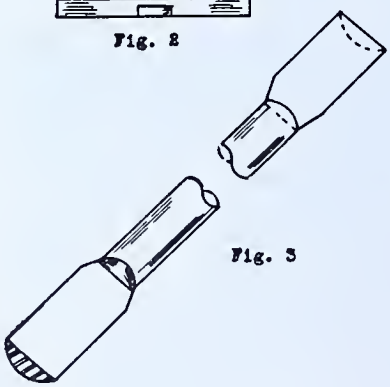


Fig. 3

1. Place a chalk line 1" in from the side of the anvil as shown in Fig. I.
2. Heat one end of the rod to a bright red. Have the helper hold the rod on the anvil so the end is flush with the chalk mark as shown above.
3. Set the swage on the rod so that it extends 1/4" over the end of the anvil (Fig.2) and hit the swage with a 2 lb. hammer. Be sure the swage is held perpendicular at all times.
4. Move the swage gradually toward the end of the work and forge until the end of the rod is similar to the one in Fig. 3. Reheat the rod when necessary.
   CAUTION: The rod must not be heated past a bright red temperature otherwise it will burn.
5. Repeat the same process with the other end of the rod. Care must be taken in order to get both ends of the rod forged flat on the same side as in Fig. 3

III. ADMINISTRATION

In a populous Commonwealth such as Pennsylvania, the problem of State supervision of industrial arts is different than is found in less populous and dominantly rural states. The wide divergence in the sizes of first and fourth class school districts, the rather distinct problems of the unit industrial arts shop and the general industrial arts shop, the variety of activities carried on in industrial arts, the lack of and varying degrees of real local supervision of industrial arts and varying degrees of teaching ability are additional factors which influence the character and amount of supervision which the Department of Public Instruction must exercise over industrial arts. This section of the bulletin reflects these conditions and factors.

The conditions, of large numbers and great divergence of students, teachers, departments and classes dictates that some standards in supervision be established and maintained. The State Department of Public Instruction attempts to maintain a reasonable balance between much rigid definition and control on the one hand and much delegation of control to local school districts on the other hand. It seeks to encourage local initiative in industrial arts programs wherever that is consistent with better educational services to learners. This section of the bulletin on supervision of industrial arts holds to that point of view. Some conditions will be defined and standards will be established. Other conditions and factors that reflect current knowledge and successful practice will be suggested and urged. It is believed that such a point of view in State supervision of industrial arts will provide a sound group of minimum essentials and at the same time encourage local districts to use initiative in providing richer educational experiences than the minimum that is actually demanded.

SECURING A LIST OF CURRENT PROBLEMS IN ADMINISTRATION OF INDUSTRIAL ARTS

Requests for lists of current administrative problems in industrial arts were sent to selected groups of city directors of industrial education, teachers of industrial arts, and superintendents of schools. These men aided through the preparation of lists of problems of class, school and city administration of industrial arts which they have been encountering. Their assistance is gratefully acknowledged.

SECURING SUGGESTIONS FOR ANSWERS TO PROBLEMS IN ADMINISTRATION OF INDUSTRIAL ARTS

Almost 200 different problems in administration of industrial arts were secured from these persons. The problems were classified, reworded in some instances, and then the lists were telescoped

through consolidation of problems that had some degree of similarity. The list of problems reported upon in this section is quite largely the telescoped list.

The classifications of questions were studied and persons in a variety of educational positions in the State who, it was believed, might contribute solutions to some of the problems, were sent one or two groups of problems. They were requested to react to as many of the questions as they cared to consider.

USE OF CONTRIBUTED MATERIALS

The contributions of these persons were drawn upon extensively in the preparation of the content of this section of the bulletin. In some instances the contributions were used just as they were prepared. In other instances parts of several suggested answers to the same question by different persons were merged. In still other instances ideas submitted by one or several persons were used in the formulation of new statements. The editor and writer has drawn freely upon all of the helpful suggestions submitted when, as and if this was possible, in any way that appeared to fit a given situation.

A. SCHOOL AND DEPARTMENTAL ADMINISTRATION

1. Should Industrial Arts Be Offered Continuously Through the Six Years of the Secondary School?

Yes. Industrial arts should be offered to pupils in all years of the secondary school. It is required in some measure of all junior high school boys. Far-seeing school administrators are requiring it or making it optional in modified form for girls. In senior high schools, the period of beginning differentiation and specialization in curriculum matters, industrial arts may well be placed on an optional basis for each of the three years. The *emphasis* upon specific aims is different in the upper level. There is an abundant and growing body of course materials providing educative experiences in cultural or liberal education in industrial arts for all six years. Pupils who have definite vocational direction probably could with profit substitute other courses for some of those in industrial arts in senior high school grades.

2. What Should Be the Administrative-supervisory Relationship of the Industrial Arts Program with the Remainder of the School System?

Supervision of industrial arts is a "staff" or advisory function. Administration is a "line" or directive function. The principal is directly responsible to the superintendent of schools for all that goes on in his building. He is directly concerned with matters of class organization, schedules and control of all departments of the school plant.

The supervisor of industrial arts serves in an advisory or "teacher-helper" capacity to the building principal and the industrial arts teacher. He attempts to have the teachers carry out the school administration's instructional philosophy and policies. He helps teachers with courses of study, methods, and class control and other problems arising from the specialized nature of the industrial arts offerings. In the matter of supplies, equipment, space, and teachers, the supervisor either is granted administrative authority to deal directly with them or he makes specific and detailed recommendations to building principals or the superintendent for their guidance.

The supervisor of industrial arts may work cooperatively with other special and general supervisors (staff officers) directly. He may work with other department heads in a school, if it is done with the approval of the principal. Much of the supervisor's success in improving instruction depends upon the ability of all concerned to cooperate. A functional chart of relationships, carefully worked out, helps much in maintaining helpful supervisory administrative relationships.

3. How Can A Local School Administrator Justify Broad Offerings in Industrial Arts Beyond the Dominant Trade and Industrial Occupations Represented in His Community?

   a. Industrial arts among other aims, has that of exploration of the occupations in which more than one-half of all American wage-earners engage. Exploration is not exploring, if it is restricted to dominant local trades.

   b. Industrial arts is intended to develop discriminating consumers of industrial products. These products come from all modern trades and industries.

   c. Industrial arts attempts to interpret modern trade and industrial life to all students, boys and girls, irrespective of their future occupations. Reference is here made to social, economic, and workers' problems.

   d. Few parents or youth work long in the community in which they receive their education. Any given community draws on many other communities and their educational systems for its workers. (As far back as 1914 L. P. Ayres[1] discovered that only one father out of six, of thirteen-year-old boys in the public schools in seventy-eight cities of 25,000 to 200,000 population was born in the city in which he was then living. Further, it was discovered that only one-half of these thirteen-year-old boys was born in the city in which they were then living.)

[1] Ayres, L. P., *Some Conditions Affecting Problems of Industrial Education in 78 American School Systems.* (Russell Sage Foundation, New York.)

The following summary of important occupational areas in Pennsylvania is helpful and suggestive. It is abstracted from *Report on Productive Industries, Public Utilities, and Miscellaneous Statistics of the Commonwealth of Pennsylvania, Department of Internal Affairs, Harrisburg, 1933.*

PRODUCTIVE INDUSTRIES OF PENNSYLVANIA

	Number of Counties Having $10,000,000 Production or More	Rank Order in Total Value of Productive Industries in Pennsylvania	Rank Order Average Number Employes in Pennsylvania
1. Metals and Metal Products	17	1	1
2. Textiles and Textile Products ..	14	2	2
3. Mine and Quarry Products	8	4	3
4. Food and Kindred Products	5	3	4
5. Chemicals and Allied Products..	4	5	9
6. Miscellaneous	4	7	6
7. Paper and Printing Industries ..	3	6	5
8. Clay, Glass, and Stone Products.	2	9	8
9. Leather and Rubber Goods	2	8	10
10. Tobacco and Its Products	2	11	12
11. Railroad Repair Shops	2	10	7
12. Lumber and Its Remanufacture.	1	12	11

4. What Is A Justifiable Grading System in Industrial Arts (a) in the Junior High School, and (b) in the Senior High School?

a. *Junior High School.*

Industrial arts is a required subject at this level. On the basis of several hundred pupils one might therefore expect that final grades would approach the normal curve of distribution. One factor operates against this principle, however, namely, that there should be no failures solely because a pupil does not develop sufficient manual skill. Many junior high schools go even further and either forbid failing grades or they approach that point of view. It should be borne in mind that the development of manual skills is important, but secondary to other factors. *From the guidance or exploratory point of view it is just as important for the pupil to discover that he does not wish to pursue more advanced courses in industrial arts and vocational industrial education as it is for him to find out that he does.*

Final grades in industrial arts in the junior high school should be a composite of grades based on the *relative importance* of such factors as related knowledge, manual skills, appreciations and attitudes, safety practices, tests, problem-solving including initiative, and possibly others—those things that are stressed in a particular course. No formula can be set up for all courses. Teachers should set up a scheme for scoring all work and changing these scores or grades into final grades.

b. *Senior High School.*

Industrial arts is an elective subject at this school level. The final grade again should be based upon the *relative importance* of different aims and supporting content of the course of study. Definite parts of the final grade should be based upon such factors as manual skills, related knowledge, attitudes and appreciations, tests, and planning including initiative. Greater emphasis is placed upon manual skills in senior high schools than in junior high schools.

5. What Are the Best Procedures for Specifying and Purchasing Supplies and Equipment?

Where the community employs a supervisor of industrial arts, all requisitions for supplies should pass through his hands for his approval. Otherwise the school principal may give first approval or rejection of a teacher's requisitions for purchases. If the school system is large, the supervisor should have some clerical help for routine paper work of this kind in order that more of his time may be spent in improving instruction.

Requisition blanks may be distributed to industrial arts teachers in January. These sheets contain names, sizes, units, quantities, and trade names of articles frequently ordered, or they may contain spaces where the information may be written in. These blanks should be returned to the proper official before the end of February so that estimates can be made for the next year's budget.

Orders for supplies amounting to $300 or more must be advertised.

Written specifications for supplies and equipment should be written in specific detail, where necessary, to prevent the substitution of commodities of inferior grade to that specified.

Equipment and supplies may be sent directly to designated schools, there checked and inspected, and placed in a school supply room or a particular shop. If the school system is large, supplies and equipment may be sent to a central receiving department from which they can be secured by teachers on requisition forms as occasion demands.

Some professional textbooks and journals in industrial arts contain samples of forms used in requisitioning and ordering, and samples of specifications. Specifications of industrial firms may also be suggestive of form. Frequently the forms used by all departments of a school system apply to industrial arts also.

6. How Should Shop Inventories Be Kept?

Inventories must be kept alive, else the teacher has no positive evidence on which to determine the status of his small tools and supplies. In the matter of supplies the active daily inventory shows additions and withdrawals and the amount on hand at the close of each day.

The inventory of small tools, machines, and equipment should be checked and brought to date at the close of each semester or academic

year. Satisfactory inventory sheets for equipment can be mimeographed or printed which provide for records over a series of checking periods. Excellent large-size inventory books for the rooms commonly found in secondary schools (including industrial arts shops and drawing rooms) are available from publishers of school books.

7. Are There Criteria for Evaluating Industrial Arts Shops?

The State regulations governing the construction of school buildings apply to industrial arts shops. These include such items as width of room in proportion to its height, amount of window space, ventilation, etc.

The following are criteria recently formulated for the establishment of industrial arts shops by the State Department of Public Instruction:

a. The minimum size of industrial arts shops in junior and senior high schools of more than 300 enrolment, should be twenty-two feet by sixty feet. Preferably the shop should be thirty feet by sixty feet.
b. In small junior or senior high schools under 300 enrolment, shops may be approved with a minimum size of twenty-two feet by sixty feet or twenty-two feet by forty-five feet.
c. In addition to the space required for shop work it is desirable to provide storage space either in a separate room or with additional length to the shop room, with the latter preferable.
d. Where necessary, because of enrolment, a room should be provided for industrial arts drawing. The minimum size for the drawing room should be twenty-two feet by thirty feet Preferably the room should be twenty-two feet by forty-five feet.

There has been research on rating scales for industrial arts shops, but no published rating scales are available. Industrial arts teachers and supervisors are encouraged to formulate shop rating scales.

8. Are There Criteria for Evaluating Industrial Arts Teachers?

A general teachers' rating score card has been prepared by the State Department of Public Instruction, Harrisburg. Copies of this form may be secured on request from the Department of Public Instruction.

A number of score cards and teachers' rating scales, designed particularly for industrial arts teachers, have appeared in professional journals[2] from time to time. Back numbers of these magazines may be consulted. A very excellent score card which may be used for self-

[2] *Industrial Education Magazine,* The Manual Arts, Peoria, Illinois.
Industrial Arts and Vocational Education, The Bruce Publishing Company, Milwaukee, Wisconsin.

rating or by supervisory authorities is the one by Schmidt[3] entitled *Score Card for Teachers of Manual Arts.*

9. Are There Criteria for Evaluating Industrial Arts Courses of Study?

Criteria for evaluating courses of study in general can be found in some professional books in general education. One which applies particularly to shop subjects is found in Friese, John F., *Course-making in Industrial Education,* pp. 23-25. These criteria for evaluating a course of study in industrial arts are adapted from a list published in Barr and Burton.[4]

In evaluating courses of study in industrial arts special attention should be directed toward such factors as correlation between the manual and informative parts of industrial arts subjects and academic subjects. Safety is an important factor. The extent to which equipment is used is important. The opportunity to develop initiative and thinking through the planning of problems is unique. The factors mentioned above are some of those which are not always found in courses of study in academic subjects.[5]

10. Are There Criteria for Evaluating Outcomes of Teaching Industrial Arts?

Many of the most desirable outcomes of industrial arts are not recognized until long periods of time have elapsed. This is true particularly of outcomes such as occupational ideals, attitudes, and appreciations.

Very few standardized achievement tests in industrial arts subjects are available. Many non-standardized tests have been printed in the professional journals in industrial arts from time to time. A carefully made teacher's test frequently is the most desirable way of evaluating testable outcomes, because the several industrial arts subjects, in their very nature, do not lend themselves readily to standardized content. Such varying factors as equipment, materials, and time available affect the content of a course of study, and the tests that should follow.

A committee of the American Vocational Association[6] has prepared lists of minimum essentials in a number of industrial arts subjects which may be used as guides in determining content and outcomes. These so-called standards of attainment are intended to be suggestive rather than arbitrary. They are planned for the junior high school grades.

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[3] Schmidt, H. W., *Score Card for Teachers of Manual Arts,* The Bruce Publishing Company, Milwaukee, Wisconsin.

[4] Barr and Burton, *The Supervision of Instruction,* D. Appleton Century Company, New York, pp. 249-51.

[5] See discussion on Evaluation in Section II of this bulletin.

[6] Committee of American Vocational Association, *Standards of Attainment in Industrial Arts Teaching,* American Vocational Association, 1010 Vermont Avenue, Washington, D. C.

11. What Should Be the Attitude of Industrial Arts Teachers Toward Salesman of Merchandise of Industrial Arts?

All salesmen should follow the usual policy of school administration so far as securing permission to call on industrial arts teachers in their shops is concerned. Frequently salesman have valuable suggestions to pass along to industrial arts teachers. They are in positions wherein they see recent developments in tools, machines, and materials. Many industrial arts teachers secure considerable help through their periodic visits. Such salesmen may be a means of keeping up to date in the new developments which occur.

12. Should Industrial Arts Shops Be Used As Home-Rooms?

Industrial arts shops may be used as home-rooms, if there is a planned space for seating (such as a demonstration theatre), where the activities of this type of room can be carried on successfully. It may be quite advantageous for some pupils of a senior high school who do not normally enroll in industrial arts classes to have such a home-room with the men teachers in industrial arts shop surroundings.

13. Should Industrial Arts Teachers Be Required to Attend Faculty Meetings?

Yes. Industrial arts teachers are regular members of the school staff. They are frequently the ones on whom principals of schools rely heavily in organizing and developing school programs. They should be leaders in faculty meetings rather than unwilling listeners.

14. What Part Should the Industrial Arts Department Play in Industrial Arts Education of the Elementary School?

Industrial arts departments frequently aid and advise classroom teachers. They often furnish materials and sometimes offer the facilities of the industrial arts shops to teachers and classes in elementary schools.[7]

15. How Should the Industrial Arts Program and the Guidance Program Be Correlated?

It is impossible to state all of the ways in which these two closely related educational and service activities may cooperate and correlate their services. The attitude of the school administration has a pronounced effect upon just what and how much cooperative effort is possible. In Pennsylvania the exploratory or tryout aim of industrial arts has long been recognized as one of the most important ones. This fact may be due to the dominance of the state in a wide range of industrial enterprises, and in the important place that vocational industrial education has assumed in the secondary and adult school levels. The widespread movement toward general industrial arts courses in Pennsylvania is due in a considerable measure to the

[7] See *Creative Hands and Purposeful Activities in Elementary Industrial Arts,* Bulletin No. 333, Department of Public Instruction, Harrisburg, Pennsylvania.

desire of school authorities to emphasize occupation finding experiences in trades and industries. The growth of a large number of industrial activities in industrial arts, as compared with the few that formerly existed, reflects in part this basic purpose of industrial arts. Enterprising industrial arts teachers employ an additional step beyond these manipulative tryouts. Through various class techniques they cause individuals, groups, and entire classes to study about other trade and industrial occupations which are related to the activities carried on in the industrial arts shop. (Through materials, operations, products, tools, and workers.)

Industrial arts teachers are in a position to assume an important place in any school-wide program of vocational guidance, particularly in the services of occupational information and placement. Some schools which have inaugurated school-wide guidance programs draw upon the service of every member of the staff who has had experiences or connections with occupations or who has made himself familiar with certain occupations. When the industrial arts teacher is placed in such a program of guidance he should be sure that he is well grounded in the theory and practice of guidance so that his teaching and advice may not be biased in the direction of trade and industrial vocations.

It should be borne in mind that in industrial arts courses which emphasize the exploratory aim that it is just as important for a student to discover that he has little interest or aptitude for trade and industrial occupations (one or as a group) as it is for him to discover that he does have interest, aptitude, and possibly ability in this group of wage-earning occupations.

In order to be assured that an industrial arts course is directly exploratory *the attention of students should be called to this matter frequently.* The exploratory manual experiences and the studies of related trade and industrial occupations which accompany in the class discussions should be written into the course of study. Many of the desirable results, from the point of view of guidance, will be lost unless the teacher continually emphasizes the exploratory purposes of the course so that pupils will become thoroughly conscious of this purpose.

16. In what Ways Does A General Industrial Arts Course Differ from A General Vocational Industrial Course?

General industrial arts courses have been discussed previously. General vocational industrial courses in Pennsylvania are planned to prepare youths for entrance to semi-skilled and other industrial occupations which require a briefer period of preparation than for the so-called skilled trades. The periods of school preparation for general industrial vocational courses are usually of shorter duration than those for the skilled trades.

The teachers in general industrial vocational courses must meet certain standards of occupational competency and experience not required of industrial arts teachers in order to be certificated. The amount of time per day and per week assigned to shop experience is greater than that in industrial arts. The work of the class must be pursued on a useful and productive basis. The Department of Public Instruction has mimeographed and printed bulletins dealing with all phases of vocational industrial education, including general industrial vocational schools and classes.

17. What Requirements Different from Those in Industrial Arts Must Be Met in Order to Secure Federal and State Funds for Vocational Industrial Education?

Much of the answer to this question is outlined above. The principal differences in requirements between industrial arts and vocational industrial education are in the qualifications and certification of shop and related-subjects teachers, in the time per week assigned to shopwork and the related subjects and in the organization and mode of conducting the shop instruction.[8]

B. CLASS SUPERVISION AND CONTROL

18. How and by Whom Should Industrial Arts Shops Be Cleaned at the Close of a Class Period and at the End of the School Day?

The concensus of opinion among successful teachers and supervisors of industrial arts would justify a principle stated approximately as follows: student cleaning should supplement not supplant janitorial service, it should be planned to develop "good housekeeping" habits, and it should provide an orderly though not necessarily wholly clean room for the next class.

Based on such a principle the following organization for cleaning can be justified.

a. Students clean their benches, tools, machines, and work places or stations at the close of each period. If floors are littered, excessive amounts can be picked up or brushed into a pile.

b. At the close of the day the paid janitorial service should thoroughly clean the shop just as all other areas of the school.

Large amounts of time spent by the students in cleaning cannot be used in learning. Teaching good housekeeping tends to develop good attitudes, but it should be kept in mind that there is also value in having a shop atmosphere, a place of manual and mental work, which is essentially different from conditions found elsewhere in a school.

[8] See Pennsylvania State Plan for Vocational Education.

19. What Is the Best Way of Handling Shop Accounts of Materials Purchased by Students?

There is no "best" way of charging, reporting, collecting, and depositing moneys received in payments of supplies issued. School, industrial arts department, and central office policies and bookkeeping practice may be controlling factors in determining procedure. Two principles may well be followed.

Report at stated intervals, as daily, weekly, or monthly.

Make charges and reports in duplicate or triplicate to protect students, teacher, and school.

Some specific procedures are as follows:

Charges:

Based on uniform bills of materials.

Reported on bills of material, charge slips in triplicate, or in class record books.

Reported to school office to be charged against a deposit fee.

Collections reported by teacher:

To school head, department head or central office.

Collections deposited by teacher:

In school, departmental or central office.

Accompanying or following reports of collections of charges.

20. What Are the Standards for the Physical Appearance of Industrial Arts Shops?

Reference is made here to the general impression created by orderliness, arrangement, etc., in other words, the "shop atmosphere." Industrial arts shops are intended to represent and interpret current industrial life. They cannot do so when they give the impression of something other than that. Shops should not be "dressed up." They should be as near like the best practice of that which they represent as it is possible to provide in school buildings. This means neat, clean, well-organized, and efficiently planned work shops.

21. What Should Be the Plan of Class Organization Where Two Teachers Teach One Large Group in One Shop?

The principle of unified control applies to this problem as it does in all productive and large-group enterprises. If one unit, or course or activity is being taught, control of all teaching problems should rest with one teacher. The other teacher becomes an assistant. If the course of study is divided into well-defined units some of which operate concurrently, the assistant teacher may assume full control of some parts. Whatever the plan it should be clearly outlined to

the students. Divided authority may be just as confusing and distasteful to students as to teachers.

22. How Should Tools and Machines Be Maintained in Industrial Arts Workshops?

It is reasonable to expect industrial arts teachers to be responsible for a moderate amount of maintenance of all equipment in their shops. It is good practice for the teacher and educative experience for those students who are sufficiently advanced. *It may well be a unit in some courses of study.* Serious breakdowns may well be repaired by paid workmen. Teachers who have many beginning students per week (300 or more) should have some time in their schedule assigned to shop maintenance. The work becomes a very real part of the "service load." The best secondary schools now weight teaching services on the basis of the "service load." Equipment maintenance should be stressed at the close of the school year rather than at the beginning.

23. Would Separate Classrooms Be Desirable in Which the Informative or Theory Phases of Industrial Arts Are Taught?

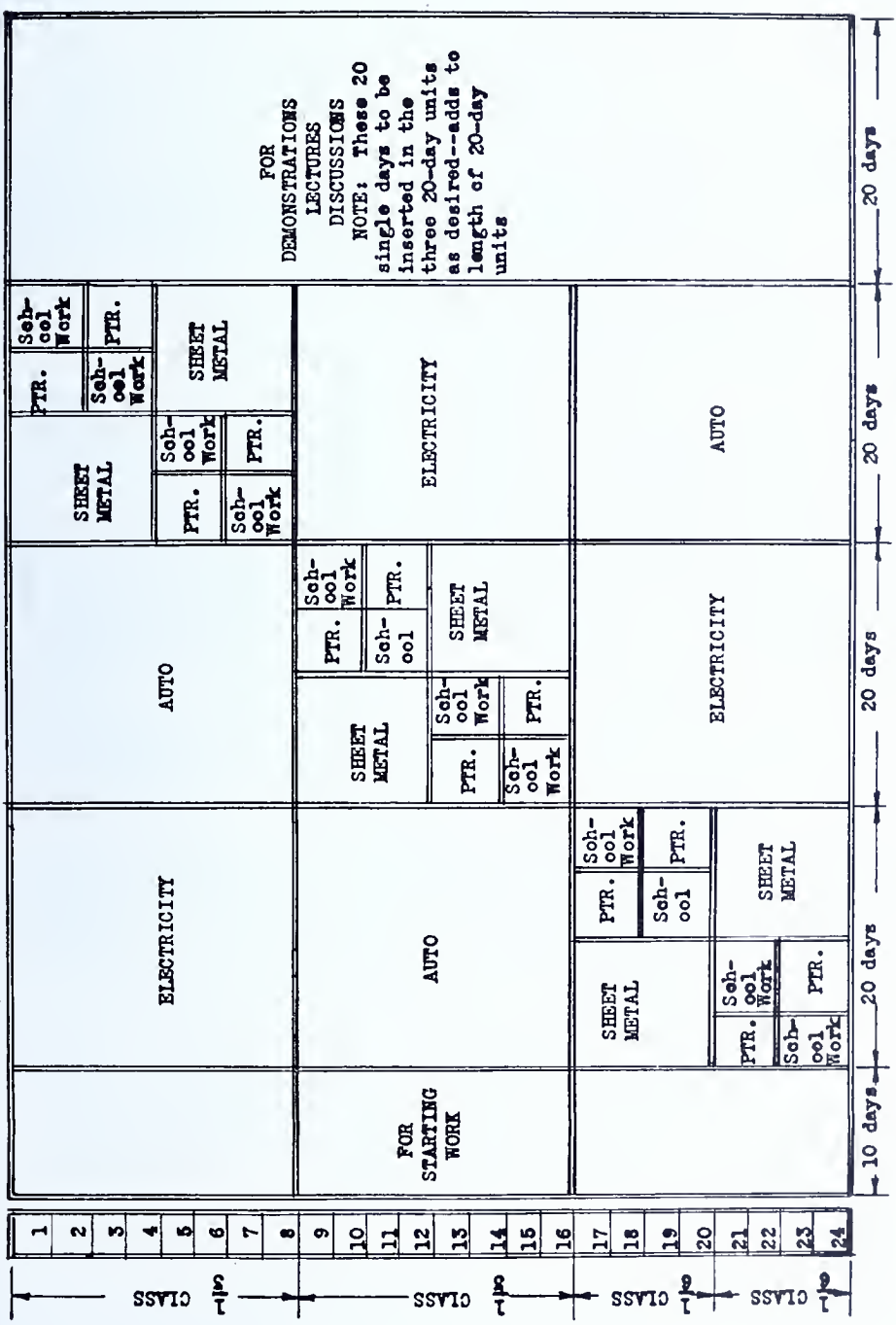
Informative content in industrial arts is of two kinds. One is essential to manual instruction and it must be taught concurrently with the manual instruction in the demonstration. Such informative content must be taught on the floor of the shop unless there is a fully equipped demonstration theatre in the shop or in a special room.

The second type of informative content is supplementary to the manual instruction and is correlated with it. It is concerned with design, consumers' appreciations, knowledge of occupations for purposes of vocational guidance, social-economic aspects of trade and industrial life, and related technical knowledge about materials, equipment, and products. These latter parts of industrial arts can be taught better in some kind of a demonstration theatre or a separate room adjoining, which may also be used by other industrial arts classes. In senior high schools this arrangement becomes quite imperative, if advantage is to be taken of the liberalized time regulations which are considered in another question.

24. What Can Be Done to Stimulate the Interests of Boys in General Industrial Arts Where Certain of the Activities Undertaken Are Not Interesting to Individual Boys?

Following are some devices and methods used to stimulate interest and effort:

Exhibits of work done with the name of the boy who has made the project.
Progress charts.
Grading chart for each class.
Field trips.



Program Chart Used in Operation of Composite General Shop for Twenty-Four Pupils, Aberdeen, S.D.

Stress the fact *to the pupils* that one aim of industrial arts is occupational exploration, and that it is just as important for one to discover that he has an interest in a trade or industrial occupation or these occupations as a group, as it is for him to discover that he has no interest or aptitude or ability in this direction.

Point out that after preliminary tryout courses a pupil will have the opportunity of selecting an elective course in industrial arts to his particular liking.

Tell the pupils at the organization meeting just what they are going to do in the course in any interesting way. Stress the fact that some opportunities will present themselves in the course for the student to select projects or work of his own liking. Stimulate group projects for a class, school or community, in which there are resultant satisfactions to the participants.

25. How Can Pupils in A General Industrial Arts Course Be Organized So That if Thought Desirable Each Pupil Will Receive Approximately the Same Kind and Amount of Instruction and Experience?

The following chart used by Samuel R. Harding in the operation of a general industrial arts shop at Aberdeen, South Dakota,[9] a number of years ago, is suggestive of one way of approaching this type of organization in a class of twenty-four (24) students meeting daily for one semester.

26. What Is to Be Done When Enrolment in Industrial Arts Classes Exceed the Provisions Made to Handle the Students?

Where enrolment in classes exceeds work places the facilities must be expanded, or the size of classes be reduced by adding an additional section or sections and possibly an additional full-time or part-time teacher. This is an administrative matter which involves the school principal and the city director of industrial arts, if there is one, and the industrial arts teacher.

27. To What Extent Can Industrial Arts Teachers Expect Cooperation in Correlating Other Subjects and Industrial Arts, as Well As Industrial Arts and Other Subjects?

Fortunately in industrial arts there are many opportunities of developing fine correlations with other subjects. Cooperative correlations between the vocational English, physical sciences, vocational guidance, commercial, and art departments have been arranged in well administered schools.

When desirable correlations involving classes in more than one department are involved, the problem is an administrative one. In large schools department heads can make some arrangements for

[9] Friese, John F. *Course-making in Industrial Education*, p. 82.

correlation. In the last analysis the principal or superintendent, who determines educational policy, provides the measure or degree to which correlations are possible.

28. What Practice Is Desirable in Conducting "Short Term" Courses in Industrial Arts in Junior and Senior High Schools?

Because of credits involved in senior high schools a course of less than one semester is seriously questioned. A course of a semester duration might be divided into several units, however.

In junior high schools short unit courses of six, eight, nine, ten or twelve weeks length can be administered in the thirty-six or forty week year. Intensive courses of this kind should provide for daily meetings or their equivalent.

29. What Are the Best Ways of Keeping Records Used in Industrial Arts Shops?

This question is almost impossible of complete and exact answer because school districts have some record forms established for the entire school system, such as for grades, attendance, tests, requisitions, and deposits. The industrial arts teacher needs special forms also, such as those for bills of material, lending of equipment between industrial arts shops, supplies and equipment inventories, requisition blanks for work or jobs done for the schools, progress charts, special forms for recording grades of manual work, possibly special lesson plan forms for manual and informative instruction, receipts for moneys collected for supplies, etc. Professional books in industrial arts and vocational industrial education, and some articles in professional magazines in industrial education provide examples of forms specially planned for industrial arts.

Two excellent rules to follow in making record forms and keeping records are:

First, arrange a record blank on the basis of known reports that must be prepared.

Second, keep only records for which there is real use.

30. How Should Non-Instructional Expenditures for Industrial Arts Be Set Up in the Ledger?

Expenditures other than instructional should be classified, coded, and entered in the correct department of the ledger just as any other expenditures of the school district.

When funds which are collected for supplies issued to students (through any avenue of collection) reach the central business office *the collections should be credited to the supplies budget of the shop, school or industrial arts department instead of being credited to some*

account of miscellaneous income. Use of the latter method of accounting makes it appear in the annual budget as if the industrial arts department is expending a considerable sum for supplies each year, for which there appears to be no return. By crediting funds received for supplies to the proper account a revolving fund is established which need be augmented only occasionally by a further budgetary allotment.

31. What Constitutes Expendable Supplies in Industrial Arts?

All materials used by students or teachers in making, repairing, depicting, or adjusting things are usually considered as expendable supplies. They are used up quickly. In many school systems certain tools which wear out or break rapidly with use, such as files, small drills, sand and emery paper and hack-saw blades are included in the supplies budget rather than the equipment budget.

C. CREDITS IN INDUSTRIAL ARTS

32. How Many Credits May be Allowed in the Senior High School for All Industrial Arts Coursework?

According to the time allotments set for industrial arts in senior high schools a student might reasonably be permitted to obtain a maximum of six units toward graduation by attending industrial arts classes two hours or more per day every day, the exact number of minutes per week depending upon the manner in which the industrial arts classes are operated. Credit to be assigned on the basis of 300 minutes per week per credit when periods are fifty to sixty minutes in length.

33. How Many Carnegie Units of Credit Should a Student be Permitted to Pursue in One Industrial Arts Subject in the Senior High School?

The exact number of credits pursued will depend upon the needs and capacities of any particular student, and upon the number of progressively graded courses offered in an industrial arts curriculum in a given school. Just enrolling in an industrial arts course, covering the same ground semester after semester, as has been done at times in the past, should be avoided. Assuming that the student is allowed to elect the activity, the maximum number permitted in all industrial arts coursework in senior high schools, may be permitted in one subject.

34. Under What Conditions of Time Measurement Can Industrial Arts be Granted Carnegie Credits in Senior High Schools?

According to a bulletin of the State Department of Public Instruction, *Graduation Standards for Secondary Schools,* there are two pos-

sible avenues of time distribution depending upon the plan of shop organization. Both are based upon the unit of academic credit which is a minimum of 200 minutes per week of actual class time, a minimum of forty minutes in a period, and presuming additional reading or study.

Plan 1. "A unit of combined classroom and laboratory work shall be a minimum of two hundred fifty minutes per week of thirty-six weeks or its equivalent. The minimum length of a laboratory period is fifty minutes clear under this section."
Interpretation

This is interpreted to mean that an industrial arts course which gave definite recognition and assigned classroom time to the informative content and aims of industrial arts, which met 250 minutes per week (five fifty-minute periods), and had no shop period of less than fifty minutes clear qualifies for one unit of credit. The likely single period of theory work of the course each week presumes *outside study*. School administrators who have been stressing some of the non-manual aims of industrial arts and asking recognition for such work now have a definite answer to their request for a more equitable time assignment than formerly was permitted.

Plan 2. "Work of a strictly laboratory nature shall be counted as having half the value of classroom work except that five periods of sixty minutes each (including change of class time) or six periods of fifty minutes each (clear) shall be counted as one unit."
Interpretation

For the large number of schools that have changed their operating schedules to the clock hour basis, this new measure of strictly laboratory (shop) education is a recognition of what has been an unjust condition in demanding double periods for all laboratory work irrespective of the length of periods.

D. TIME STANDARDS

35. What Length of Period is Most Desirable in Industrial Arts?

In senior high schools the amount of time assigned to an industrial arts course is specified. For purposes of school administration the sixty-minute period has much in its favor. Fifty-minute periods are permissible, but somewhat harder to schedule. The State sets a minimum of fifty (50) minute periods. There is no maximum length of period specified. This is a recognition of the accepted principle that long periods in industrial arts are more desirable than short periods.

Two fifty- or sixty-minute periods running in succession is a better arrangement than two periods with an interim between. The reason is that in a double period a smaller part of the total time available in minutes is lost in getting the work of all members of a class actually started and in bringing the various activities to a close *before* a given signal of dismissal.

In junior high schools the length of period for industrial arts should be as long as is possible from an administrative standpoint. Class meetings of less than fifty-five or sixty minutes provide more time for actual instruction if they are doubled, one following the other immediately. A sixty-minute period permits the teaching of a brief informative lesson and manual practice, or a manual demonstration with time for immediate practice.

36. How Many Hours per Week Should be Assigned to Industrial Arts in Each of the Six Years of the Secondary School (Assuming a Thirty-hour Week)?

In Pennsylvania industrial arts is required a *minimum of two periods* per week of all boys in junior high schools, including grades VII, VIII, and IX. It must be general in character, and be based upon the maturity and the experiences of the pupils. It must be continuous throughout the three years. (The corresponding practical arts courses in homemaking for girls require the same minimum time and the same length of period.)

In junior high schools the two, four, or five-period week may well be raised upward to as many periods as necessary for those groups in which more of this type of education fits the needs, interests, aptitudes, and abilities of the youths being served. Reference is not made here to those pupils who are classified under "special education."

Investigations show that the common practice in many communities in Pennsylvania, of assigning the minimum of two periods per week in the seventh, eighth, and ninth grades, is less time than that allotted in many junior high schools of superior standing. The concept of the several pioneers in the junior high school movement was that this school should be a school of "exploration" or of "over-views." The exploratory or tryout aim of industrial arts is rated highly in our Commonwealth. Industrial arts forms one of three chief avenues of junior high school exploration, occupational, for boys; the other two being exploration of self and of academic or informative course areas. *It is impossible to achieve the aims of the current diversified type of industrial arts in the junior high school in the minimum time of two periods per week.*

A study of time allotted to industrial arts in a number of large cities and some states which have progressive programs of education in junior high schools particularly, reveals that the amount of time assigned to industrial arts in junior high schools varies as follows:

A city of 600,000—240 minutes per week
A city of 500,000—270 to 720 minutes per week
A city of 75,000—120 minutes per week
A city of 2,000,000—up to 500 minutes per week
A city of 250,000—300 minutes per week
A city of 1,500,000—300 to 360 minutes per week

In some communities additional space, equipment and teachers are needed. In others, the industrial arts teachers and school administrators need to catch the new vision of the contributions which industrial arts can make in an industrial nation and era.

Another recent study of time assigned to industrial arts in junior high schools, by Bertin,[10] showed the following distribution of time as revealed from fifty-nine cities of varying size outside of Pennsylvania in thirty-six states:

	Time in minutes		
	7th Grade	8th Grade	9th Grade
Average time devoted to required industrial arts, excluding Pennsylvania	180	178	136
Average time devoted to elective industrial arts, excluding Pennsylvania			288
Average time recommended for industrial arts, excluding Pennsylvania	250	253	315

E. COSTS

37. What is a Reasonable Cost per Pupil-hour for Instruction in Industrial Arts (salaries, supplies, depreciation)?

Costs vary so greatly between districts that no one figure should be quoted at the present time as representing the average cost of industrial arts education throughout the State or the United States. In a few cost studies that have been made thus far within and without the State a few common denominators do seem to exist. These common denominators indicate the usual cost relationships among the various subject matter fields.

The following generalizations are made as the result of a study of a number of cost surveys.[11] The reader must remember, however, that these generalizations are made as the result of an inspection of a limited number of cost studies and that exceptions may easily exist.

a. The general impression that industrial arts is an expensive subject seems to be unjustified in view of the findings of such cost studies as have been made.

[10] Bertin, Jules R. *A Study of the Amount of Time Devoted to Industrial Arts Education in Grades Seven, Eight and Nine*, Research, Pennsylvania State College, 1938.
[11] Shuman, John T., *Cost of Teaching Industrial Arts*. Research, Pennsylvania State College, 1939.

b. The cost of industrial arts depends chiefly upon the local organization, enrolment, salaries, and other factors that are merely phases of the local situation. The cost of industrial arts education does not vary from other subjects as the result of characteristics peculiar to this subject only.

For example, it is true that industrial arts classes do require supplies, but classes in chemistry require chemicals; industrial arts classes require machinery, but amortized over twenty-year period this machinery is no more expensive per pupil hour it is in use than are textbooks which must be renewed in other classes every few years.

c. The cost of industrial arts is comparable to that of subjects such as chemistry and physics. In fact the cost of the latter two subjects is frequently higher than the cost of industrial arts in the same district, depending upon various local conditions. It also seems to be true that the cost of industrial arts is often comparable to the cost of teaching mathematics, especially during the tenth to the twelfth years. These latter equalities of cost are due largely to the smaller size of advanced mathematics and foreign languages classes of college preparatory groups.

A fairly safe way of estimating unit costs of instruction in industrial arts is to place such instruction about twenty per cent higher than the *average* of academic subjects.

38. What Is a Reasonable Cost per Pupil-hour for Supplies in Industrial Arts?

The cost of supplies in industrial arts in the junior high school grades will generally not be as great as that for the senior high school grades. The amount varies greatly in different subjects. For example, the cost of supplies for a course in craftwork such as leather, art metal or wood carving might be considerably higher than for a course in which sheet metal is secured from large used tin cans, or a course in printing where a few odds and ends of paper constitute most of the material actually consumed. One study of the costs of supplies to secondary schools in fourth class school districts in a county in Pennsylvania[12] revealed that they amounted to one cent per pupil-hour for industrial arts instruction. (Essentially general industrial arts.)

39. What Are the Approximate Costs of Installation of Various Kinds of Industrial Arts Shops?

The Department of Public Instruction, Bureau of Instruction, has prepared estimates of costs for industrial arts shops based on costs of 1938. They are as follows:

[12] Carey, R. E., *A Comparative Study of the Costs of Instruction in Industrial Arts and Other Forms of General Education in the Senior High Schools of Pennsylvania in Fourth Class School Districts in Luzerne County, Pennsylvania.* (Unpublished Masters' Thesis, Pennsylvania State College, 1937), page 35.

General shop—24 pupils, 1 teacher, room 22 feet by 60 feet or 30 feet by 60 feet—$1,000 to $3,500

General shop—18 pupils, 1 teacher, room 22 feet by 45 feet—$1,000 to $2,000

Unit shop—24 pupils, 1 teacher, room 22 feet by 60 feet or 30 feet by 60 feet—$1,000 to $3,800

Following is a more detailed estimated cost of a general industrial arts shop, size 22 feet by 45 feet, grades VII-XII, inclusive:

Metal work	$ 948.95
Electrical work	131.11
Woodwork	796.90
Drawing	79.97
Total	$1,956.91

Another suggested list of equipment for a general industrial arts shop, 22 feet by 60 feet, or 30 feet by 60 feet, or grades VII-XII, inclusive, is as follows:

Metal work	$1,550.80
Electrical work	184.14
Woodwork	1,085.82
Drawing	142.15
Printing	544.34
Total	$3,507.25

Specifications for a unit industrial arts metal shop for twenty-four pupils in junior and senior high schools recently prepared by the Department of Public Instruction calls for an approximate cost of $4,155.00. A similar unit industrial arts woodwork shop for twenty-four pupils was estimated at approximately $2,028.88.

The figures quoted above are estimates and can be used only as general guides. For additional information about equipments and layouts see Part IV of this bulletin, "Floor Plans and Equipments."

40. Is There a Possibility of Securing Special Aid in any Form for Industrial Arts?

Up to and including the year 1938, the General Assembly has provided no special funds for instruction or equipment in industrial arts. Public Works Administration grants for building have under certain circumstances included equipment. As a part of general education, it is considered on the same basis as other subjects so far as reimbursement of teachers' salaries is concerned under the Edmonds Law.

41. How Can the Somewhat Greater Costs of Industrial Arts Over the Average of Other Classroom Subjects in General Education be Justified?

Knowledge and interpretation of current life problems has long been recognized as an important function of education. Occupational life in the United States today is dominantly trade and industrial, including transportation and many service occupations. The desirable outcomes include manual skills, and informative content about materials, workers, management, sources, products and problems surrounding these factors. Industrial arts is the chief vehicle through which industrial life is really interpreted to young people.

From a psychological point of view industrial arts has a unique contribution in that it provides situations in which learning takes place through the sense of touch (feeling) as well as through the senses of sight and hearing.

From another point of view industrial arts is unique in that it provides a wholly natural setting for "project" education and for learning situations in which problem-solving is stressed. The results of the problem-solving stand before the learner in physical form and they can be judged objectively.

Industrial arts throughout the last three centuries has consistently been one avenue of educational reform. It is tied up intimately with the lives and the experiments of most of the great educational reformers, of the seventeenth, eighteenth, and nineteenth centuries.

42. Who Should Pay for the Materials Used in Articles Made by Pupils?

Under ordinary circumstances the board of education should pay for materials used in the *required* practice work and projects in industrial arts in the junior high school years. Such materials are comparable to the books and other school materials furnished to students in other classes. Where elective projects are made in which the cost of materials may run higher than is the case in the required work the student is usually called upon to pay for these more costly materials or larger amounts of materials. In senior high schools where more of the articles made are on an elective basis and where more materials may be used it is generally the practice to have students pay for the material which they use.

43. What Should be the Policy of Replacement of Industrial Arts Equipment?

Common practice in schools where the factor of depreciation is considered is to reduce the value five per cent of the original cost per year. This means that standard equipment should be replaced in approximately twenty years. Some items last longer than this and other items should be replaced in ten or fifteen years. A five per cent depreciation on standard tools and machinery is approximately that used by producers for equipment in the same category.

44. Should Students in Industrial Arts Shops Do Work for the Board of School Directors and Should They Be Paid a Minimum Wage per Hour Somewhat Like the Federal Government Pays National Youth Administration Students?

Some persons in education are opposed to students in industrial arts doing any work (construction or repairs) for a board of education. This attitude is based on the fact that such practices have been detrimental to industrial arts in some places where the practice has been abused.

The industrial arts teacher or the city director should have the authority to approve or reject requisitions for such work. If it is to be undertaken, it should be definitely planned for in the course of study so that specific educational outcomes will accrue to the student as a result of their experiences. Where such work is included it is necessary to set up a program of personal assignments so that all students may profit by these experiences, but no student or group of students shall be penalized by excess amounts of work under such assignments. It should be scheduled as a part of the activities of a class in much the same way that a designated unit of some kind is included in a general industrial arts course. The important factor is the matter of control, so that the unique educational values inherent in such work may be accomplished and equally distributed.

The question of payments to students for work of this kind which is truly educational cannot be justified in-as-much as it is done on school time. When such work is done in out-of-school hours, the students might be paid a designated amount in districts where there is no objection to it on the part of organized labor.

F. SAFETY

45. What Safety Precautions Should Be Carried Out in Industrial Arts Shop Installations?

46. What Penalties Apply to School Districts for Improper Guarding of Machines?

47. What is the Earliest Age at Which Machines May Be Operated by Pupils in School Shops?

48. What is the Financial Responsibility of School Districts for Physical Injuries That Occur in Industrial Arts Shops?

For information on the above four items refer to *Safety Education in Industrial School Shops,* Bulletin No. 334, 1938, State Department of Public Instruction, Harrisburg, Pennsylvania.

G. TEACHERS AND SUPERVISORS

49. Should Industrial Arts Teachers Have Home-Room Assignments?

An industrial arts teacher in a secondary school is a "regular" teacher. He should assume the same responsibilities and have the same privileges as all other members of the staff. His teaching is a part of general education, meaning education for all. Assuming home-room responsibilities helps to place an industrial arts teacher as a regular member of the teaching staff in the minds of teachers, pupils, and the school administration. In taking this point of view about home room assignments it is assumed that an industrial arts teacher, because of peculiar duties connected with his work in handling and maintaining supplies, equipment, and records, shall have some time assigned to these special duties, if he is to be responsible for a home room. As a man teacher his contribution to the home room program should be greatly desired by the school administrators.

50. Should Industrial Arts Teachers Be Paid on the Basis of the Regular Salary Schedule or be Shown Special Consideration in the Matter of Salary?

Many school administrators feel that the salary schedule demanded by the Commonwealth for beginning teachers is fair and equitable, irrespective of the subjects that they teach. Even in the case of beginning teachers, however, the particular contributions that men teachers can make in a secondary school may reasonably create a demand which cannot be met through the minimum salary scheduled under the Edmonds Law. Superior industrial arts teachers frequently demand and secure beginning positions at salary levels above the State schedule for beginning teachers.

Industrial arts teachers of experience who have established themselves frequently are paid salaries above the State schedule. The factors of supply and demand generally operate. In the past there has been no evidence of an over-supply of industrial arts teachers in Pennsylvania.

In school districts which desire that the industrial arts teacher have some wage earning experience in trades or industry in addition to meeting the academic and professional requirements for State certication, it is reasonable to expect that they will be paid on a schedule higher than that called for by the minimum State certification requirements.

51. What Are the Present Certification Requirements for Industrial Arts Teachers?

The certification requirements for industrial arts teachers include graduation from an approved four-year teacher education curriculum

including a minimum of at least eighteen semester hours in industrial arts. See Question 60.

52. How Can a Vocational Industrial Shop Teacher for Unit Trade Schools, With Minimum Requirements for Such State Certification, Be Certificated to Teach His Trade Subject in Unit Shops in Industrial Arts?

At the time of the preparation of this bulletin no specific certification has been set up for city supervisors or directors of industrial arts in Pennsylvania. Up to the present time it has been assumed that city directors of vocational industrial education have been qualified to supervise industrial arts education. In some cities not having vocational industrial education programs the board of education has created the position of city supervisor of industrial arts and has elected a person to that office. It is quite possible that the position of city supervisor or director of industrial arts in school districts employing a stated minimum number of industrial arts teachers might justify a certificated position.

Where a vocational certificate is a valid certificate to teach in the secondary field, this certificate may be extended, in accordance with the certification regulations, to include industrial arts where the applicant has completed the minimum requirements for the addition of industrial arts subjects to a valid secondary certificate. The minimum preparation now required for the addition of a subject to a certificate is eighteen semester hours of industrial arts, which becomes progressively increased until 1940, when the requirements will be thirty semester hours.

The certification regulations require that minimum preparation be completed in each of the specific industrial arts subjects that are to be added to the certificate which is extended to cover this field.

This program will eventually lead into the desirable program where industrial art steachers will have completed a four-year curriculum leading to the baccalaureate degree in the field.

53. How Can an Academic or Agricultural Teacher Be Certificated in Industrial Arts?
(See certification requirements for industrial arts teachers.)

54. What Are the State Certification Requirements for City Supervisors of Industrial Arts?

City supervisors of industrial arts or city directors of vocational industrial education who are responsible for the supervision of industrial arts should have some education in the philosophy and special problems of industrial arts education. Several years of successful teaching experience in industrial arts is an important adjunct to successful leadership in the position of city supervisor of industrial arts.

55. What Are the Chief Qualifications of Competent Industrial Arts Teachers?

In a study made by Fries[13] the most desirable qualities in industrial arts teachers appear in the following order:

Knowledge of subject taught
Executive ability and class management
Personality
Adaptability and tact
Good character
Methods
Health and appearance
Industrial experience and contact
General scholarship
Professionalism

To this list today one would most certainly add knowledge of philosophy of industrial arts education. The teachers' rating scale for industrial arts teachers by Schmidt, previously referred to, provides another example of the relative importance of various qualities in industrial arts teachers.

56. What Practical Wage-earning Experience Should an Industrial Arts Teacher Have in Order Properly to Interpret Current Industrial Life of His Students?

In all studies of the qualities of teachers the item ranking highest has almost invariably been "mastery of subject matter." Among industrial arts teachers this mastery may be quite intensive in one subject or it may be less intensive in a variety of industrial subjects. In all cases industrial arts teachers are using the materials, tools, machines, products, and workers in industry as agencies for teaching about the various problems of modern trade and industrial life. These problems involve tools, materials of industry, informative content, ideals, attitudes, and appreciations. One cannot expect a teacher to teach and interpret in an occupational area unless he has had actual wage-earning experiences. Such experiences may precede, accompany or follow a teacher's collegiate professional education. These wage-earning experiences serve as additional education in skills, knowledge, and appreciations of industrial workers and management and the associated problems. A teacher with such a background of vocational and educational preparation plus first-hand experiences in social and economic problems of industry, is better fitted than one who has had collegiate preparation only.

The amount of wage-earning experiences in terms of weeks or months, and the spread of such experiences in different trade and industrial and service occupations cannot be specified. In the light of

[13] Friese, John F. An Occupational Analysis of Industrial Arts Teaching Together with an Evaluation of Preparatory Teacher Training for the Same. (An unpublished thesis at the University of Wisconsin, 1929, pp. 40-41.)

current demands upon industrial arts teachers it is probably more valuable for industrial arts teachers to get desirable wage-earning experiences in several trade and industrial occupations rather than having all of the experiences in a single one.

57. What Assistance Is Available to Communities that Desire Expert Assistance With Plans for Establishing Industrial Arts Departments?

Upon application to the Department of Public Instruction a representative of the Division of Industrial Education will be sent to confer with local school administrators and to assist them in making plans for and establishing industrial arts departments. The Department of Public Instruction approves facilities, equipments, and supplies. It aids teachers in improving courses of study. It promotes expansion of existing programs and it stimulates teachers organizations for the study of common problems such as the establishment of minimum essentials of subject-matter in various subjects.

Letters addressed to the heads of the departments of industrial arts at the State Teachers Colleges at Millersville and California also will bring help and cooperation from these institutions.

The service of the several area coordinators in industrial education attached to the University of Pennsylvania, Pennsylvania State College, and the University of Pittsburgh are available to local school officers in connection with problems involving industrial arts and vocational industrial education.

The heads of departments of industrial teacher education at the three above named institutions may also be consulted about plans for industrial arts departments.

58. Are the State Requirements for Certification of Industrial Arts Teachers Sufficiently High in the Several Shop Subjects?

The State requirements in shop experience and mechanical drawing for industrial arts teachers are minimum requirements. Local school officials may require competency in skills and knowledge of the subjects to be taught which are in excess of the State's minimum requirements. A number of cities in the Commonwealth demand competency in occupational skills and knowledge of industrial arts that cannot be mastered in a four-year teacher education course.

59. Shall Industrial Arts Teachers Be Permitted to Teach Activities not Named on Their Certificates?

Industrial arts teachers should not be permitted to teach industrial arts in unit shops or units in general industrial arts courses in subjects not named on their certificates. It may happen on occasion that an

individual pupil may select a problem in which the work on a project may involve an extension into occupational areas not covered by the teacher's certificate. Such extensions are incidental and are not a violation of the teacher's certificate because he is not teaching a course in the added subject. Industrial arts teachers who direct extra-class activities often find in them opportunities for spreading into areas not covered by their teaching certificate which affects only class activities. Such extra-class work may take the direction of hobby interests, home repairs, consumed education, and even educational exploratory work.

60. If Requirements for Industrial Arts Teacher Certification Are Revised, What Is the Probable Nature of the Revision?

A committee appointed by the Department of Public Instruction to suggest needed changes has made the following report.

Note: It is not intended that the following regulations should be retroactive.

A college certificate may be extended to include the teaching of industrial arts on the satisfactory completion of courses selected from an approved teacher education curriculum in industrial arts as recommended by the authorities offering the curriculum (action of State Council of Education, December 2, 1938).

Until September 1, 1939.....eighteen semester hours
After September 1, 1939.....twenty-four semester hours
After September 1, 1940.....thirty semester hours

IV. FLOOR PLANS AND EQUIPMENT SPECIFICATIONS

This section, dealing with floor plans and equipment specifications, is prepared in a manner that is intended to furnish assistance to school administrators and architects alike, insofar as providing desirable physical provisions for industrial arts is concerned. It must be admitted that such a limited treatment cannot serve every conceivable need or situation that may exist or arise. However, most of the suggestions are sufficiently adaptable to allow it to serve as a guide toward the development of new industrial arts areas, or toward the reconstruction of existing ones.

The comprehensive exploratory values of junior high schools cannot be satisfied by merely furnishing to pupils of such schools those limited values to be obtained from one type of industrial arts activity. Neither can the elective program of industrial arts for senior high schools operate to any degree of its possibilities with but one industrial arts activity. Careful attention is therefore called to the several types of general shops illustrated by suggested floor plans, and equipment specifications farther on. It is in general shops such as these, or in an organization in which students are rotated through a number of unit shops—each shop emphasizing a different activity—that industrial arts functions best.

Location of Workshops and Drawing Rooms

Areas to be used for the carrying on of industrial arts activities should not be on sub-ground levels. Sub-ground levels are still acceptable for such purposes as school central heating plants, and some recreation areas: for instance, rifle ranges and bowling alleys.

Due to an ever increasing safety consciousness, it seems unnecessary further to point out the advisability of locating industrial arts areas above sub-ground levels. The necessity of providing maximum light for activities, many of which possess inherent hazards, should alone be sufficient reason. However, it should be borne in mind that dampness constitutes hazards to equipment and supplies in the form of oxidation, swelling, and warping in adding to its adverse effect upon the health of the occupants of the room.

School shops having as part of their equipment, machines which are relatively massive, and whose operation sets up heavy vibrations, should be located on the first floor. Such shops, as well as shops in which large projecis might be developed, should have double doors opening to the outdoors. A driveway leading to these doors is desirable. Other types of industrial arts shop and drawing and design rooms can just as well be located on upper floors of school buildings.

Many acoustical materials are now on the market. These should be used in ceiling, side wall, and floor sound-proofing in shops in which the work carried on is noise producing. Nevertheless, it will be well to locate such shops in the vicinity of other noisy school activities.

Internal Physical Characteristics

Sufficient natural and artificial light should be provided so that a scientifically predetermined foot-candle optimum is available at each working station at all times. The foot-candle optimum will, of course, be much higher for drawing and design areas, and for shop operations demanding intense eye concentration, than for shop activities requiring less intense eye activity.

Inasmuch as artificial light should, so far as possible, be indirect, or semi-indirect in character, the ceilings and side walls (down to within a few feet above floor level) should be painted a flat ivory, bluish white or light cream. The lower sections of the side walls may be painted light tan, green, or any other suitable color.

Ceiling heights should not be less than eleven feet in the shop proper, and a ceiling height greater than this is suggested in shops containing wood and metal working activities, to facilitate the handling of long stock.

Floors of public school industrial arts areas should be of material which does not become slippery with wear. For most types of shops, a wooden sub-floor laid on sleepers and covered with tongue-grooved oiled wood flooring proves very satisfactory. In areas where metal is worked hot, an earth, cement, tile, or metal covered floor should be used.

Room proportions shown on the floor plans farther on in this bulletin are based upon multiple and fractional standard classroom sizes as suggested by the School Buildings Division of the Pennsylvania State Department of Public Instruction. The purpose of this is to make the construction of industrial arts areas adaptable to standard school building construction. Such areas should never have a proportion greater than one to two. Where possible, by wing or separate building construction, a ratio not exceeding one to one and one-half should be followed.

Public school industrial arts shops, and drawing and design rooms should be self-contained. Working areas, remote from the shop proper are hindrances to good discipline and to efficient teaching. Sometimes, however, certain areas demanding extreme cleanliness may well be partitioned off within the shop. Where this is done, the upper sections of the partitions should be of panel glass construction to provide maximum visibility from practically all locations within the shop. When available storage rooms outside the shop proper prove advantageous.

Work Shop Equipment

Equipment lists are included in this bulletin. Revised lists, made periodically, may be had from the Department of Public Instruction on request. Virtually all of the suggested equipment specification lists represent the maximum optimum. No one should entertain the feeling that effective industrial arts programs cannot be conducted if local budgets are able to provide but a part of the cost to which each of these lists will total. In cases where limited budgets must be adhered to, extreme ingenuity must be practiced by those who are responsible for securing the equipment. The teacher who has been selected to teach a particular industrial arts activity should be consulted in connection with the matter of equipment selection. Frequently, material equipment economies can be effected by revising courses of study, without any ill results so far as course outcomes are concerned. Furthermore, numerous specified equipment items can be constructed by students in the school shops under the supervision of the teacher.

Safety should be the prime consideration in specifying and installing school shop equipment. Up-to-date equipment is likely to be the safest, inasmuch as reputable manufacturers, through engineering research, determine, and build into their products, constant improvements. Approved safety guards should be standard equipment on all power machines specified, and, as such, should be used without fail.

The platitude "you get what you pay for" applies to the purchase of industrial arts equipment. Approximate unit prices indicated in the equipment specification lists conform with this truism. School equipment, because of the learner element involved, is frequently taxed to the limit; and, when used constantly, the depreciation is inclined to be rapid. With this thought in mind, the specified items are suggested on the basis of minimizing maintenance and replacement costs.

Student Capacities of Workshop

The number of students to be accommodated in each workshop indicated throughout this bulletin should not be considered as a maximum optimum, but rather as an absolute maximum. The education values to be obtained from the program will be seriously hampered if this fact is ignored and an attempt is made to crowd even "just one more" into any one of these workshops.

Expert opinion differs widely with respect to the number of student working stations that should exist in a workshop in relation to the number of students enrolled in a class. For this reason, no attempt will be made here to state a definite relation or even to show a range with respect to this. However, the fact that progressive methods of organizing and teaching industrial arts activities are made possible to the extent that class enrolments are reduced, within reasonable limits, is not an over-statement.

In order that the reader may be given a more comprehensive view of workshop planning and selection of equipment, principles underlying these activities precede the floor plans and equipment lists.

Other excellent suggestions along this line may be found in the Bruce Specification Annuals issued for the last nine or ten years, the February issue of the Industrial Arts and Vocational Education Magazine for February in 1933, 1934, 1935, 1936, and in the March issues of 1937 and 1938.

A. PRINCIPLES OF PLANNING INDUSTRIAL ARTS WORKSHOPS

Basic Considerations

A workshop shall be thought of not only as a place for making projects, but equally as a place for planning, investigating, testing, experimenting, consulting, evaluating. In short, the workshop shall be thought of as a place for thinking as well as feeling and doing.

Areas Represented

Any basic industrial process or material adaptable to pupil use shall be considered as a suitable and desirable basis for an activity in an industrial arts workshop. Study, investigation, testing, and demonstration should be carried on so as to represent a still greater variety of industries.

The reference material or library shall be considered as much a part of the workshop as any tool, machine, or area, and should be provided for and utilized in much the same manner.

The instructor should have some designated area which includes a desk, typewriter, and filing cabinets, preferably located away from noise and dirt, and commanding as full a view of the workshop as possible.

Local limitations such as insufficient space or funds should be met by reducing the number of accommodations in several or all areas rather than by eliminating a complete area.

Nature of Equipment. The maturity of the pupils who are to use the workshop should be a guiding factor in the planning of equipment, particularly as regards size, weight, power, capacity, and safety of machine and hand tools.

Safety factors shall be given first consideration in all workshop planning. They become paramount in the placing of equipment. Any area shall be visible from every portion of the workshop. Such points

also include: the location of service facilities, the width and location of aisles of travel, and such items as light, color, and acoustical treatment. Machines around which exist zones of danger such as: Jointer, bandsaw, hacksaw, and lathe should be so placed as to reduce—or better, eliminate—the possibility of pupils' being in line of danger. Such zones should be indicated on the floor by painted lines.

Handling of hot metal in moulding, forging, welding, and the operation of hazardous machines such as the circular saw, jointer, lathes, bandsaw, shaper, printing press, and paper cutter, shall be isolated from all traffic and distracting interference as far as possible.

Interference. Pupil work stations shall be so placed that interference from adjacent workers and aisle travel will be reduced to a minimum.

Flexibility to meet the challenge of changing programs and pupil needs should be provided for in any workshop plan and installation. This implies that unassigned floor areas may occur, that large equipment should never be so integral with the building that it cannot be shifted, that individual drives on all machines become a necessity, that an abundance of well-distributed service outlets should be provided, in keeping with the desirability of semi-portable equipment. Expansion and alterations should be anticipated as a means of meeting further demands on floor space by new equipment or areas, larger enrolments, and character of the program.

Workshop Size and Shape

Size of the workshop shall be determined by the general rule of allowing a minimum floor area of at least fifty square feet per pupil. This figure includes storage space, tool room, finishing room, dark room, planning room, etc., and is useful for workshops planned to accommodate twenty-five pupils or more. Due to the necessity of certain fixed items regardless of pupil capacity, the figure of fifty square feet per pupil must be increased proportionately as the classes reduce in size. Workshops designed for operation by a single teacher should, for administrative reasons, not exceed 3,000 square feet in floor space.

Shape of the workshop is most important. It should in general be rectangular and have a proportion of one to one and one-half or one to two. Irregularly shaped workshops such as "U" and "L," should be avoided as quite unsuitable to school needs.

Workshop Arrangement

Areas should be so placed in relation to one another that an optimum working relationship exists. For example, areas of moulding, forging, and welding have processes and materials in common and

should be placed in close proximity to one another. The same might be said of machine metal work, sheet metal work, automotives, and electricity as well as photography, printing, bookbinding.

Cleaning Space. Equipment occupying floor space should always be placed to allow for ease of cleaning around the base.

Tool and supply centers should be as centrally located as possible to reduce traffic and traffic interference to a minimum. Tool areas located in the center of the workshop are probably ideal in this respect if they do not obstruct vision in the workshop. Long, narrow rooms, while not adapted to the central location of the tool area, may place it against the wall in the middle of the long side. Workshops more nearly square in shape may develop a tool area only counter-high without upper screening as an excellent solution. Certain large pieces of equipment such as attachments peculiar to some one machine might well be placed adjacent to the machine on a small panel. This practice reduces traffic and demands at the tool room, which will make for less confusion and better workshop administration. Certain small tools peculiar to a single area may well be stored and distributed in kit form to reduce tool-room service to a minimum and speed up handling. This treatment is particularly adaptable to: foundry, machine lathe, wood lathe, automotives, ceramics, and drawing.

Sequence of Operations. Certain machines should be arranged with reference to sequence of operations and their relationship to other areas. The jointer is usually placed to the right and rear of the circular saw, but close to it,since these machines are frequently used alternately. The circular saw should be placed opposite lumber storage space to reduce the disturbance and danger of handling long lengths in the shop. Further attention should be given in placement of machines to assure adequate clearance for the work to be done.

Auxiliary Facilities

Storage and supplies for all areas may well be concentrated in a single storage room for ease of administration and control. No space, as shelving and flat surfaces, should ever be provided for storage unless some specific article or material is assigned to it. A place for nothing in particular is a place for everying in general, and anything belonging in the workshop should have an assigned place.

Rough Trimming. Power hack saw, paper cutter, hand saw, tin snips, or squaring shears, saw horses, and other equipment used to prepare stock to size might well be located permanently in the stock room. Such practice avoids the necessary hazard of handling large and awkward sizes of stock in the work areas of the workshop and eliminates the problem of returning unused pieces.

Racks and shelving should be provided for the orderly storage of all materials including lumber, sheet metal, steel, paper, and hardware. Project storage, on the other hand, may be provided elsewhere to care far partially completed and finished pieces. Such storage space should be designed to protect the pieces stored.

Student lockers, for administrative reasons, are best distributed about the workshop rather than concentrated in a single area. Ganging and crowding is thus avoided. The pupils immediately scatter on entering. For purposes of economy of space, these lockers should be placed under bench tops where they become the bench body itself, thus serving a dual purpose. Distribution of lockers throughout the room is well provided for by this method.

Architectural and Service Considerations

Exhibits. Lighted exhibit and display cases are highly desirable and should occur both in the workshop itself and in central locations, probably main corridors, in the principal part of the building.

Bulletin boards shall be considered essential to the workshop. One or more general bulletin boards should be placed in central positions such as the entrance to the workshop and near the tool center. In addition to general bulletin boards, it is considered desirable to have a small board mounted near or in each work area. Posts and small wall sections may well be utilized in this manner. Wall space for permanent displays and a daylight projection screen should be provided. Blackboard space in several or all areas is considered advantageous. Extensive blackboard as well as bulletin-board space in the planning area is quite essential.

Utilities. Gas, water, and electricity, should be thought of as essential utilities for every industrial arts workshop. A general distribution of outlets, particularly the electrical, should be provided.

Washing. A sufficient number of washing facilities should be provided in the workshop proper to allow a washing position for each ten pupils in the class.

Toilet facilities should be provided in connection with the workshop or at least accessibly nearby.

Natural light shall be thought of as desirable and advantageous, though not dependable because variable. (See *Artificial Light* below.) Precision equipment such as machine lathes, milling machines, drill presses, circular saws, jointers, jig saws, wood lathes, grinders, and drawing tables, should probably be given preference in location with reference to natural light. Certain operations such as clay modeling,

wood carving, and finishing are more effectively carried on under natural light because of the need for sensitive light and shade definition and delicate color discrimination. Natural light is best, controlled by means of venetian blinds of light color and flat finish. The direction of the light source must be given careful attention in the placement of all equipment. Working positions directly facing windows are generally not satisfactory, with the possible exception of bench work. Even this practice may be objectionable along east, south, and west elevations.

Artificial light should supplement natural lighting to the extent that the artificial light *alone* will provide illumination that conforms with good lighting practice. Good general lighting shall be provided to an intensity of at least two-foot candles at bench height in all areas and this shall be supplemented with additional local lighting on all machines and areas where precision work is carried on. In no case should a bare lamp bulb ever be visible. The surface of radiation from any light source should be as large as possible to reduce surface brightness —and hence glare—to a minimum.

Paint for walls, ceiling, and equipment should be semi-gloss of a good reflective and diffusing value selected in harmonious and pleasing colors artistically treated in a simple manner. Glossy surfaces on benches, machines, and walls, are to be avoided because of the glare they produce.

Power and light controls should be centralized on a control panel conveniently located in the workshop. The tool room, if one is used, serves well as a central control for both power and light.

The ventilation system for the workshop should be separate and distinct from the rest of the building for mutual benefit. A circulating washed air system for the workshop would be most desirable from the point of view of health and maintenance. All excessive heat and fumes should be cared for by ventilating the areas involved by means of hoods and exhaust systems. Flues should be provided through which all gases may be carried to the roof.

Dust and refuse collecting systems piped below the floor are to be considered highly desirable.

Heating units should be placed so as to avoid occupying useful space and interference with operations. This suggests the consideration of recessed units or units suspended from the walls or ceiling.

Acoustical treatment is considered a necessity in all industrial arts workshops. Bot walls and ceilings should be so treated. A minimum treatment would at least provide for ceiling absorption of not

less than fifty per cent. Maximum absorption possible is deemed desirable especially if a ceiling treatment alone is used. (See also *Ceilings* on this page.)

Floor materials shall be suitable to the area in which they are used. Wooden floors, probably maple or blocks-on-end, is deemed most suitable at present for all areas except those dealing with hot metals; namely foundry, forging, and welding. Here the floor may well be concrete, flush with the wooden floor or a wood floor covered with rough surfaced steel plate. Soundproofing below the wood flooring is to be recommended regardless of the location in the building. Rubber mat floor covering should be used as a safety precaution where machine operators stand. This is particularly important on smooth and slippery floors.

Walls, from the floor up to a point of five feet, should be surfaced with some durable material easily cleaned and of a pleasing texture and color. Mat glazed brick, tile, formica micarda, enameled one-eighth-inch prestwood, asbestos, tile, or vitralite is satisfactory. Above this point walls should be plastered or treated with a sound-absorbing material.

Ceilings should be not less than eleven feet in height, and all workshops should be ceiled with a material of a high coefficient of absorption—not less than fifty per cent.

Partitions, preferably of glass and steel, are desirable and essential for certain areas in the workshop. Ideally, the maximum integration probably exists where no partitions are present; thus in practice, partitions when used should preserve as far as possible the unity of the workshop by maintaining maximum visibility between the areas. This implies a forty-two-inch steel partition, the remainder being glazed to the ceiling.

PRINCIPLES OF SHOP-PLANNING

1. All parts of the shop should be visible to the teacher.
2. Natural lighting should be at least one-fourth of the floor area of the shop.
3. When possible, have the teacher's desk in the vicinity of the entrance.
4. Block off or fill up recessed spaces.
5. Arrange equipment to permit free use of aisles.
6. When possible, lockers should be inside the shop and recessed in the walls.

See also the reference by Dr. William E. Warner in Bruce's *School Shop Annual* for February, 1934.

7. The floor should be adapted to the type of shop, avoiding concrete when possible.
8. Provide for maintenance of tools and equipment.
9. Place the key cabinet where it is most convenient.
10. Machines commonly used in sequential order should be placed in the order of their operation.
11. Shop doors should open outward.
12. Avoid placing students where exposure might affect their health.
13. Arrange machinery for maximum safety.
14. Utilize to a maximum naturally lighted areas.
15. The blackboard and bulletin board should face the light.
16. Machines should not be placed on columns or pipes which will transmit sound to other rooms.
17. Avoid an open-beam ceiling.
18. Walls and ceiling should be a light color.
19. Equip with self-contained portable machines whenever practicable.
20. Have transparent partitions between the shop and its auxiliary rooms.
21. All the shop should be on one floor when one instructor is in charge.
22. Do not permit students to regularly use more than one entrance to the shop.
23. Have one large entrance for each shop.
24. Locate tool room and tool panels so as to avoid excessive travel.
25. Adequate storage space should be provided.
26. The benches and storage equipment should be large enough to accommodate standard sizes of material.
27. Have fire extinguishers of the correct type and size readily available.
28. Keep obstructions out of line of light.
29. Choose north light when possible.
30. Have soundproof floor, ceiling, and foundations to machines.
31. All machines should be controlled by a master switch under lock and key.
32. Grandmaster-key, master-key, and submaster-key all locks to doors of building.
33. Where necessary, have a dust collector for machines.

34. Windows should extend to the ceiling from a point as low in the wall as practicable.
35. Place equipment so as not to interfere with opening of doors.
36. Provide steel cases and waste containers for inflammable materials.
37. Place the most frequently used equipment near the center of operation.
38. Have an adequate first-aid equipment readily accessible.
39. Have metal covered glue table.
40. Locate machines so as to accommodate maximum-sized material.
41. Ground all power machines and insulate all metal furniture in an electrical shop.
42. Plan the shop so as to reduce disciplinary problems to a minimum.
43. Distribute items of similar equipment so as to be of value to all workers.
44. Paint safety zones around dangerous machines.
45. Equip dangerous machines with effective guards.
46. Provide exits for fumes, gases, and other injurious substances.
47. Do not have large amounts of lumber, supplies, and materials openly accessible to pupils.
48. Have equipment so located as to avoid all shadows possible on working areas.
49. In determining proper lighting facilities, secure the recommendations of a competent lighting engineer.
50. Avoid using the shop as a passageway to other rooms.
51. When practicable, have all floor space of the same story on the same level.
52. Drinking fountains may well be installed.
53. All controls should be centralized at the teacher station.
54. Tool shelves should be between five feet and eight feet—no dark corners.
55. Active tools in plain sight for instant checking.
56. Windowsills should be sloped.
57. There should be a safe and adequate distribution of current for portable tools.

B. PRINCIPLES OF INDUSTRIAL ARTS EQUIPMENT

The obvious basis for industrial arts equipment selection is the educational program which is to be achieved through its use. Cost, as such, is but a minor consideration at best and should be considered only after the program has been fully projected.

Each tool, each machine, each bench, and each piece of apparatus must provide for a maximum of pupil participation in its use. In other words, mere pressing of a button to perform an operation defeats learning. In addition to this, each item of equipment must represent a basic industrial process. It is only through an understanding of these processes and their effects that the pupil is enabled to interpret the infinite number of applications so characteristic of American life. Learning through experience for purposes of orientation in an industrial society requires a variety of equipment rather than a duplication of specialized items.

Safety is secondary only to educational criteria. This means that all equipment must be designed and built, and, in turn, selected and used, with specific reference to the size, height, strength, mental development, and experience of the individuals who are to use it. Thus the capacity, weight, power, speed, and size of machines for industrial arts classes should be determined by the nature of the pupils who use them.

Obsolescence is also a factor which industrial arts programs and school officials must learn to recognize and face. American industry "retools" periodically for a world where change is the only certainty. The school is faced by the same certainty. The equipment manufacturer is now producing less costly equipment of smarter design to encourage periodic replacement. But, the industrial arts program of today finds itself equipped, in effect, with horses and buggies in an age of complex machine transportation. If American people want their children to cope successfully with such an age, then the lessons for equipment selection seem to be most plain.

1. Functional Features:

a. Machines should be of the unit type in order to provide maximum efficiency, safety, and flexibility of arrangement. Combining a circular saw, mortiser, and jointer on a single standard reduces the usefulness and efficiency of each machine, besides resulting in unnecessary interference and hazards.

b. Machines should be designed and used for only one type of work. A drill press, for example, which is in such constant demand, should not be expected to serve as a router, a shaper, a sander, and a hollow-chisel mortiser in addition to its principal function of drilling.

c. Automatic feed and control devices obscuring the principles of a machine should be avoided for industrial arts classes except for reasons of safety. Automatic feeds on mortising machines and drill presses, quick gear changes on lathes, and automatic press feeders are cases in point.

d. Machines should be mounted on individual bases, preferably enclosed on all sides to the floor to facilitate cleaning both machine and floor. A machine mounted on a bench destroys in part the usefulness of both bench and machine.

e. The equipment provided in a workshop should be of a size or capacity which will take care of the bulk, but not necessarily all, of the work which anyone would like to do. For example, there may be a distinct educational value in having a pupil himself take some work directly to an industrial shop or plant, where he will make new contacts, observe industrial methods, evaluate production costs, note merchandising procedures, and experience being handled as a customer.

2. Safety Features:

a. Essential safety features such as circular saw guards, jointer guards, pulley and belt guards, should be designed and supplied as an integral and not as a separate item of equipment.

b. All moving parts of power-driven machines must be guarded or enclosed except those used directly in the operation involved.

c. All hand-operated machines that present hazards such as squaring shears, punch presses, and paper cutters, shall be provided with effective guards.

d. All moving parts of motor-driven equipment, whether guarded or not, should be free of projections such as set-screws, knobs, and keys.

e. Guards, when used, must be simple in design, positive in action, and interfere as little as possible with the operation of the machine. Guards that adjust themselves automatically to the work being done are to be preferred over manual types.

f. All grinding equipment should be provided with shields of laminated safety glass.

g. All motors should be equipped with overload protective devices of the thermal-relay or circuit-breaker type. These devices should be incorporated in the case with the motor switch control.

h. The size, capacity, and power of any machine shall be determined with reference to the age, strength, height, and mentality of the pupils who are to operate it. It is questionable, for example, if any machine in a junior high school workshop need be driven with a motor exceeding one horse power.

3. Design Features:

a. The average elbow height of individuals who are to use a bench or machine shall be the reference point in specifying the operation level of said bench or machine.

b. All machine tools should have individual motor drives, controls, and stands.

c. Power for any machine should be adequate to operate the equipment under its full rated capacity without unreasonable overloading of the motor.

d. "V" type belts are usually to be preferred to flat belts from the standpoint of power transmission and general efficiency. Flat belts, if used, should be of the endless type and may be preferred as a protective measure because of slippage on excessive overloads. This is particularly true where machines may be locked by jamming, as in the case of an engine lathe or milling machine.

e. All reciprocating or revolving machine parts that work at high speeds should be balanced and counterbalanced to reduce vibration to a minimum.

f. Machine standards should be sturdy and rigid in order to provide a solid base free from weaving and twisting for the machine it supports.

g. All handles, wheels, and mechanical controls shall be of easy access to the operator, arranged not to interfere with each other, and be electroplated with an anti-corrosive metal.

h. Speed controls should be convenient, safe, positive, and of a range sufficient for the work for which the machine was designed and the experience level of the operator; e. g., beginning printing press operators require an unusually slow press speed.

i. The use of detached knobs and wrenches for adjusting and operating a machine should be avoided as far as possible.

j. Machine parts such as saw blades, drill spindles, and mortise bits should be easily and quickly adjusted and interchanged without damage to the parts.

k. Machines might well include housing space for extra parts and attachments that are used exclusively with that machine.

l. Machine or cabinet bases shall not interfere with the movements or comfort of the operator; e. g., toe room shall be always considered in the design.

m. Machines shall be designed to allow the maximum amount of working space around the point of operation.

n. Power machines should be provided with switches placed within the operator's *natural* reach and vision while the machine is in operation but so located that accidental switching is avoided.

o. Motor-driven machines of one horse power or less shall be equipped with a toggle or push-button type switch operating in a vertical position and placed within natural reach of the operator.

p. The quality and kind of materials used in the construction of machines for school use shall be comparable to that used in machines for industry.

q. Sealed roller or ball bearings shall usually be considered preferable to other types of bearing.

r. Where possible, motors shall be housed within the machine, but made easily accessible for maintenance.

s. Collectors for shavings, dust, etc., shall be an integral part of the machine. The machine shall, however, lend itself to installation of a central dust-collecting system.

t. Flexible molded rubber power cords should be supplied and used in connection with all portable and semi-portable equipment.

u. The need for periodic lubrication should be reduced to a minimum through such means as sealed bearings packed in grease or oil. Parts needing periodic lubrication should be fitted with snap-cover oil cups or alemite zerk fittings located for ease of identification and servicing.

v. Machines shall be designated to operate with a minimum noise factor. At no time should the noise of any machine exceed seventy decibels.

w. Machines should be cushioned preferably with rubber mountings furnished as an integral part of the machine.

x. Machines embodying sheet-metal construction should be treated with a noise-absorbing or dampening medium glued or sprayed on inside surfaces.

y. Machines should be painted a distinctive color sufficiently light to have a light-reflection factor of at least forty, be without glare, easy to clean, and of neat appearance.

z. "Local" lighting shall be incorporated as an integral part of machines wherever possible.

C. WORKSHOP LAYOUTS AND SPECIFICATIONS

1. Printing and other graphic arts....Senior High School
2. Metals .....Senior High School
3. Woods .....Junior High School
4. Drawing and design .....Senior High School
5. General .....Junior-Senior High School
6. General .....Junior High School
7. General .....Senior High School

Note: Because of the changing nature of equipment prices and designs, equipment specifications will be revised from time to time. Lists may be obtained by writing to the Department of Public Instruction.

1. Printing and Other Graphic Arts—Senior High School.[1]

The fact should be borne in mind that for some students enrolled in this print shop the values of the experience gained will be pre-vocational; for all students, however, the values will be of a general educational nature. This shop is not designed to furnish vocational preparation.

The very fact that this shop is not intended to produce master printers makes it possible to include the spread of varied activities in many phases of graphic arts provided for in this print shop.

Even in a senior high school, there are some students who cannot be taught to feed electrically powered presses safely. So that all students may gain some experience in press operation, it will be noted that a hand operated platen press has been specified. It will be further noted that a ten-inch by fifteen-inch electrically powered platen press is the one specified. This press would be ample for most types of poster printing, or for the production of a small school paper. Incidentally, the silk screen processing facilities, which have been suggested, should be largely depended upon for poster work because of the added flexibility.

In connection with the type faces specified for letter press printing, a variety is desirable in order to prevent monotony, and to develop appreciation of the selection of a suitable type face for each job.

Many economies can be effected by the construction of some of the equipment items by the students under the supervision of the print shop teacher, or perhaps in other shops in the school. Some such items are the bookbinding press and clamps, the copper drain board, the etching press, the sewing frame and the silk screen frames.

A supplementary dictionary is one of the books that should be included on the reference shelf.

[1] Explanatory notes to be used as reference in considering the suggested floor plan and equipment specifications for a senior high school industrial arts print shop, twenty-two feet by sixty feet, to accommodate twenty-four pupils.

Whatever is done with respect to deleting certain items, or substituting for others, it is felt that the teacher who is responsible for setting up and administering the course of study should be fully consulted beforehand.

SUGGESTED EQUIPMENT SPECIFICATIONS FOR A SENIOR HIGH SCHOOL INDUSTRIAL ARTS PRINT SHOP, 22 FEET BY 60 FEET.

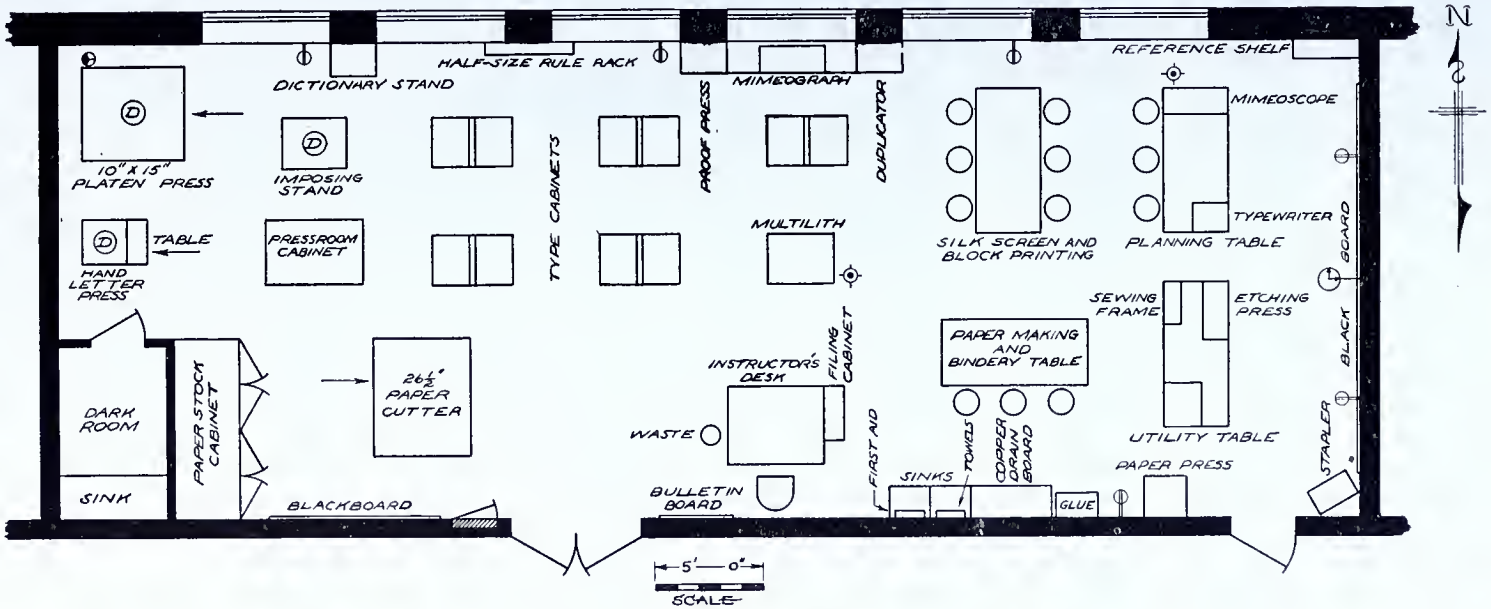
Shop to Accommodate 24 Students

Quantity	*Name and Description*	*Approximate Unit Price*
	LETTERPRESS PRINTING—12 STUDENTS	
	Machines and Accessories	
1	10-inch x 15-inch Platen press, with single disk, combined pinion guard, crank shaft, 3 semi-steel chases, 6 roller stocks, and 2 wrenches	$135.00
	Extras for 10-inch x 15-inch press:	
	Casting rollers for 10-inch x 15-inch press (3 rollers)	4.35
1	Fibre fly-wheel guard	3.50
1	Platen guard	10.00
1	Motor bracket with belt tightening adjustment, including pulley	25.00
1	Endless leather belt	5.00
1	Wire mesh belt guard	10.00
1	Counter	6.75
1	Brake	11.00
1	¼ h.p. motor, variable speed, pedestal control, belt drive, for local current	77.00
1	Pilot press, 6½ inches x 10 inches and accessories	92.50
1	Proof press, 12½ inches x 16 inches, with galley thickness bed plate, steel cabinet with ink plate, rag bin with brayer	75.00
	Large Equipment	
1	Pressroom cabinet with 30 inches x 30 inches drying racks, ink compartment, roller compartment, and mixing slab	180.00
1	Imposing table, 31 inches x 39 inches, wood construction, one side containing drawer, space for reglet and wood furniture. Opposite side containing chase rack for five 10-inch x 15-inch chases, and galley unit for forty-four galleys	121.00
1	Imposing stone 31 inches x 39 inches	93.00
5	Composing stands with double tier working top sloping both ways, wood construction, capacity for sixteen cabinet front cases, overhead lead and slug rack	65.00
1	Dictionary stand on rollers	5.25
1	Half-size rule rack	7.00
2	All steel tables, 23¾ inches x 36 inches	19.00
6	Stools, 24 inches high, double riveted steel legs, 18 inches diameter, wood seat	2.60

Quantity	*Name and Description*	*Approximate Unit Price*
	SMALL EQUIPMENT	
1	Benzine can, 1 quart size	$1.75
1	Benzine brush, 6 inches x 2 inches	.50
1 Dozen	Spring tongue gauge pins	1.80
1	Hickory mallet	1.00
1	Proof plane, 3½ inches x 8 inches, felt covered	1.25
1	Type planer, 3½ inches x 8 inches	.65
1 Dozen	Quoins, Size number 1	1.35
1	Quoin key, Size number 1	.65
25	Pressed steel galleys, 8¾ inches x 13 inches	.41
3	Line gauges, 12 inches; pica, nonpareil, and inches	1,00
2	Ink knives, 6-inch blade	.75
1 Pair	10-inch roller supporters	.55
1	Dictionary	7.50
8	Composing sticks, 2 inches x 6 inches, stainless steel	3.90
1	Composing stick, 2 inches x 12 inches, stainless steel	4.80
1	Composing stick, 2 inches x 10 inches, stainless steel	4.50
1	Slug cutter, with gauge	5.00
1	Numbering machine, six wheel	11.50
1 Set	Wood carving tools	2.50
2 Sets	Linoleum carving tools, each set consisting of two handles and six cutters	.75
1	Oiler, ½ pint	.14
1 Pair	Tweezers, 4½-inch blade	.23
1	Leader box	.50
3	Hump-back rules, 16 picas long	.25
	PLANOGRAPHIC PRINTING—2 STUDENTS	
	MACHINERY AND ACCESSORIES	
1	Multilith	350.00
1	Duplicator	128.00
	STENCIL WORK—3 STUDENTS	
	SMALL EQUIPMENT	
1	Silk screen printing unit, 14 inches x 22 inches	12.00
1	Mimeograph	30.00
	Intaglio Printing—3 Students	
	MACHINERY	
1	Etching press	25.00
	SMALL EQUIPMENT	
1	Glass tray for etching	1.25
1	Etching needle and burnisher	1.00

Quantity	*Name and Description*	*Approximate Unit Price*
	Bookbinding and paper making—4 Students	
	MACHINERY	
1	Foot power wire stapler	$48.00
	LARGE EQUIPMENT	
3	Stools, 24 inches high, double riveted steel legs, 18-inch wood seat	2.60
4	Bindery tables, 36 inches x 80 inches, steel base and top	35.00
1	Paper press	
	SMALL EQUIPMENT	
1 Pair	Binding clamps	
1	Sewing frame	3.00
1	Pair shears, 10 inch cuts	1.80
1 Pack	Bookbinder's needles, (25)	.50
2	Bone folders, 1 inch x 8 inches	.30
1	Glue pot, thermostat heat control, 1 quart capacity	15.50
1 Pair	Eyelet punch and pliers	2.50
	Miscellaneous	
	MACHINERY AND ACCESSORIES	
1	Hand lever paper cutter, 26½ inches, including 1 knife, 1 measuring tape and four cutting sticks. Cutter to be equipped with approved safety device	250.00
1	Typewriter	80.00
	LARGE EQUIPMENT	
	All steel table, 23¾ inches x 10 feet	39.00
	All steel stock cart, with casters 24 inches x 36 inches	25.00
1	Teacher's desk of wood construction, 28 inches x 58 inches, double pedestal	22.75
1	Swivel chair with arms	11.00
1	Steel filing cabinet, four drawers, 14⅜ inches wide, 24 deep and 51 inches high	33.00
3	Stools, 24 inches high, double riveted steel legs, 18-inch wood seat	2.60
	SMALL EQUIPMENT	
1	Mimeoscope	7.50
3	Steel waste basket 18 inches x 24 inches high	1.75
1	Covered waste can with foot tredle, 12 inches x 18 inches high	4.00
1	Paper towel cabinet	1.00
1	Cork bulletin board, 36 inches x 48 inches	8.50
1	First aid cabinet with mirror door and supplies	6.50

Quantity	*Name and Description*	*Approximate Unit Price*
	TYPE AND SPACING MATERIALS	
1 Font	23 A 46 a, 6 point Roman Oldstyle	$2.25
1 Font	21 A 42 a, 8 point Roman Oldstyle	2.70
1	20-pound font, 18 A 35 a, Roman Oldstyle, 10 point	17.00
4	20-pound fonts, 17 A 32 a, Roman Oldstyle, 12 point	16.00
1	20-pound font, 14 A 26 a, Roman Oldstyle, 14 point	15.00
1 Font	9 A 20 a, 18 point Roman Oldstyle	4.35
1 Font	6 A 13 a, 24 point Roman Oldstyle	4.65
1 Font	5 A 9 a, 36 point Roman Oldstyle	4.95
1 Font	23 A 45 a, 6 point Roman Oldstyle Italic	2.25
1	20-pound font, 17 A 32 a, Roman Oldstyle Italic, 12 point	16.00
1 Font	20 A 42 a, 8 point Roman Oldstyle Italic	2.70
1 Font	5 A 10 a, 36 point Roman Oldstyle Bold	8.30
1 Font	4 A 8 a, 48 point Roman Oldstyle Bold	11.65
1 Font	3 A 5 a, 60 point Roman Oldstyle Bold	12.05
1 Font	12 A 45 a, 12 point Text	3.70
1 Font	10 A 30 a, 18 point Text	4.35
1 Font	9 A 19 a, 18 point Sans Serif Roman	4.35
1	20-pound font, 14 A 26 a, San Serif Roman, 12 point	16.00
1 Font	3 A 4 a, 60 point Sans Serif Bold	14.25
1 Font	3 A 4 a, 48 point Sans Serif Bold	9.50
1 Font	4 A 6 a, 36 point Sans Serif Bold	6.75
3 lbs	2 point brass rule	2.00
1 Font	2 point miters for brass rule	1.15
3 lbs	10 point line leaders, four dots to the em	8.85
1 lb.	10 point braces and dashes	.85
1 lb.	10 point fractions	.82
½ lb.	Parentheses and brackets	1.25
1 assort.	Thin spaces with quarter-size case	6.60
60 lbs.	2 point leads, 24-inch lengths	.20
75 lbs.	6 point slugs, 24-inch lengths	.20
25 lbs.	Metal furniture (1 font)	9.25
5 lbs.	6 point spaces and quads	.73
5 lbs.	8 point spaces and quads	.73
20 lbs.	12 point spaces and quads	.73
10 lbs.	10 point spaces and quads	.73
10 lbs.	18 point spaces and quads	.73
5 lbs.	24 point spaces and quads	.73
5 lbs.	30 point spaces and quads	.73
5 lbs.	36 point spaces and quads	.73
5 lbs.	48 point spaces and quads	.73
5 lbs.	60 point spaces and quads	.73
60	California job cases, cabinet front	2.02
10	Cases, cabinet front	2.02
4	Quarter size rule cases	1.25
1 Font	Reglet	22.00
1 Font	Furniture	22.00



SUGGESTED FLOOR PLAN FOR A SENIOR HIGH SCHOOL INDUSTRIAL ARTS PRINT SHOP

22'—0" x 60'—0"

SHOP TO ACCOMMODATE 24 STUDENTS AS FOLLOWS:

LETTER PRESS PRINTING — 12 PLANOGRAPHIC PRINTING — 2 STENCIL WORK — 3

BOOKBINDING AND PAPERMAKING — 4 INTAGLIO — 3

SUGGESTED EQUIPMENT SPECIFICATIONS FOR THIS SHOP BEGIN ON PAGE

2. Metals—Senior High School[2]

The fact should be borne in mind that for some students enrolled in this metal shop the values of the experience gained will be prevocational; for all students, however, the values will be of a general educational nature. This shop is not designed to furnish vocational preparation.

The storage space indicated on the floor plan is not the total amount available, inasmuch as it is possible to construct copious storage space under many of the work benches. In addition, some of the smaller unfinished individual work can be stored in student lockers throughout the building.

If equipment rearrangements are to be made, care should be taken to let the soldering furnaces and melting furnace remain in the same general location in order that gas need not be supplied to remote locations.

Where possible, a hood should be installed over the melting furnace, and the fumes led to the outside.

If cost reduction is necessary the greatest saving could, of course, be gained by deleting the machine shop unit, or by reducing the number of students to be accommodated in machine shop activities. If curtailment is to be practiced with respect to the machine shop area, a lathe or two should be the first deduction. The power hack saw could well be the next item dropped. Those students dropped from machine shop work could then be placed in cold iron work, for instance, with very little outlay for additional cold iron working equipment.

An attempt has been made to present in this bulletin plans for a metal shop which will better meet the objectives of industrial arts by giving opportunity to the student to explore not only the major basic metal working processes, but to do it through a wide selection of metal media.

Whatever is done with respect to deleting certain items, or substituting for others, it is felt that the teacher who is responsible for setting up and administering the course of study should be fully consulted beforehand.

[2] Explanatory notes to be used as reference in considering the suggested floor plan and equipment specifications for a senior high school industrial arts metal shop, twenty-two feet by sixty feet, to accommodate twenty-four students.

SUGGESTED EQUIPMENT SPECIFICATIONS FOR A SENIOR HIGH SCHOOL INDUSTRIAL ARTS METAL SHOP 22 FEET BY 60 FEET.

Shop to Accommodate 24 Students

Quantity	*Name and Description*	*Approximate Unit Price*
	SHEET METAL—5 STUDENTS	
	Machinery and Accessories	
1	Squaring shears, 30 inches	$96.00
1	Bar folder, 30 inches, adjustable	60.00
1	Slip roll forming machine, 30 inches x 2 inches	30.00
1	Combination crimper and beader, 24-gage	15.00
1	Burring machine with burring roller and extra roll	15.00
1	Wiring machine with wiring rolls	15.00
1	Turning machine with A and B turning rolls	15.00
	Large Equipment	
1	Sheet metal work bench with stake plate, 60 inches x 30 inches x 31⅝ inches high	70.00
1	Sheet metal work bench, 60 inches x 30 inches x 31⅝ inches high	65.00
	Small Equipment	
4	Soldering blocks of magnesium carbonate, 12 inches x 12 inches x ½ inch	.75
2	Soldering furnaces without lining	3.57
1 Pair	Soldering coppers (1 pound per pair) with handles	.30
2 Pairs	Soldering coppers (2 pounds per pair) with handles	.40
1 Pair	Soldering coppers (3 pounds per pair) with handles	.50
1	Electric soldering copper, ⅞-inch tip, 125-Watt	2.00
1 Each	Rivet sets, sizes 2, 4, 6, 8	.40
1 Each	Hand groovers, sizes 2, 3, 4	.75
1	Tinner's circumference rule	4.00
3 Pairs	Wing dividers, 8 inches	.78
1	Hollow punch, ½ inch	.84
1	Hollow punch, ¾ inch	1.26
1	Hollow punch, 1 inch	1.68
1	Hollow punch, 1½ inches	2.52
3	Prick punches	.20
5	Solid punches, sizes 6, 7, 8, 9, 10	.20
1	Tinner's raising hammer, 28 ounces	1.70
1	Handy seamer, ⅞ inch x 3½-inch blade	1.58
2	Riveting hammer, 10 ounces, with handle	.75
2	Setting down hammer, 10 ounces, with handle	.75
3 Pairs	Tin snips, 3½-inch cuts, straight	2.30
1 Pair	Tin snips, 3½-inch cuts, curved	3.30
5	Scratch awls, ring type, 6 inches	.30
1 Pair	Round nose pliers, 6 inches	.55
3 Pairs	Flat nose pliers, 6 inches	.55
2 Pairs	Combination pliers, 6 inches	.75
1 Pair	Cutting nippers with removable jaws, 10 inches	2.80
2	Rubber mallets	1.30
1	Fibre mallet, 2-inch x 4-inch head, ½ pound	.90

Quantity	*Name and Description*	*Approximate Unit Price*
5	Steel squares, 8 inches x 12 inches	$.78
1	Beakhorn stake	21.00
1	Candle mould stake	8.00
1	Coppersmith's square stake	8.00
1	Conductor stake	9.00
1	Hatchet stake	7.00
1	Hollow mandrel stake	10.00

MACHINE SHOP—5 STUDENTS

Power Machines and Accessories

3	Metal turning lathes, 9 inches x $3\frac{1}{2}$ feet, underneath belt motor driven, motor to fit lathe and local conditions large and small face plates, tool post, thread cutting stop, center rest, follower rest, two 60° lathe centers, spindle sleeves, and wrenches. Lathes to be equipped with quick change gear box	383.00
1	Metal turning lathe, 13 inches x 4 feet, including same equipment as above lathe	560.00
1	Hand wheel and draw in collet chuck attachment to include hand wheel, hollow draw bar, spindle nose cap, and wrench, taper closing sleeve of tool steel, and one $\frac{1}{8}$-inch split collet, for 9-inch lathe	25.00
6	Tool steel split collets, 3/16 inch, 1/4 inch, 5/16 inch, $\frac{3}{8}$ inch, 7/16 inch and $\frac{1}{2}$ inch	4.75
1	Graduated taper attachment for 9-inch lathe	55.00
2	Thread dial indicators for 9-inch lathe	9.00
1	Micrometer carriage stop for 9-inch lathe	11.00
1	Milling and key way cutting attachment for 9-inch lathe consisting of milling attachment, two "V" blocks, crank handle for feed screw, wrench, bolts and nuts	45.00
1	Milling arbor to fit 9-inch lathe	6.00
1	Spiral end mills for 9-inch lathe, $\frac{1}{4}$-inch diameter	4.80
1	Angular milling cutter, R. H. cutter, L. H. angle, $1\frac{1}{4}$-inch diameter, 7/16 inches thick, $\frac{3}{8}$-inch hole, 24 N. F. threads/inches	4.50
2	Adjustable thread cutting stops for 9-inch lathe	2.50
1	Fitted three-jaw universal lathe chuck for 13-inch lathe	28.00
1	Fitted four-jaw independent lathe chuck for 13-inch lathe	23.00
2	Fitted three-jaw universal lathe chuck for 9-inch lathe	28.00
4	Fitted four-jaw independent lathe chuck for 9-inch lathe	23.00
3	Fitted 3-jaw drill chucks, $\frac{1}{2}$ inch	6.50
2	Solid arbors to fit drill chucks for 9-inch lathes	1.00
1	Solid arbor to fit drill chuck for 13-inch lathe	1.00
12	Tail stock spindle centers for 9-inch lathe	2.25
4	Tail stock spindle centers for 13-inch lathe	2.25
8	Tool holders, 4 straight, 2 L. H., 2 R. H. for 9-inch lathe	1.25
3	Tool holders, 1 straight, 1 L. H., 1 R. H. for 13-inch lathe	1.35

Quantity	*Name and Description*	*Approximate Unit Price*
1	Boring bar and holder, $\frac{1}{4}$ inch x 6 inches, for 9-inch lathe	$3.00
1	Boring bar and holder, $\frac{1}{2}$ inch x $7\frac{1}{2}$ inches, for 13-inch lathe	4.10
2	R. H. cut-off tools for 9-inch lathe	1.50
1	R. H. cut-off tool for 13-inch lathe	1.50
1	Knurling tool with medium rollers for 9-inch lathe	3.00
2	Threading tool holder for 9-inch lathe	2.50
1	Knurling tool with medium rollers for 13-inch lathe	3.50
1	Threading tool holder for 13-inch lathe	2.50
10	Safety lathe dogs, sizes $\frac{3}{8}$ inch x 3 inches x $\frac{1}{4}$ inch	4.80
1	Shaper 16-inch stroke ram, complete with motor, switch, belts, pulleys, vise and wrenches. Motor phase and cycle to meet local conditions	935.00
3	Tool holders, R. H., L. H. and straight, to fit shaper	2.50
1	Power hack saw to hold 12-inch—14-inch blade, to be equipped with water pump, hydraulic back stroke release	206.00
1	Drill press with three jaw chuck fitted to spindle, back gear, gear driven, upright drill with motor adapted to drill press and local conditions, drill press spindle fitted with number 2 Morse taper. Size of drill press, 21 inches	235.00
1	Electric drill and bench stand to fit drill, drill chuck capacity, 0-$\frac{1}{2}$ inch	75.00
1	Drill press vise, 6-inch jaw, 6-inch opening	12.00
1	Grinder on floor stand, 2 wheels 7-inch x 1-inch width, fine and course, $\frac{1}{2}$ H. P. motor with phase, voltage and cycle to fit local conditions, shatter-proof glass shields and lights fitted to grinder	69.50
	LARGE EQUIPMENT	
1	Tool rack, to be constructed, 30 board feet of lumber at 10 cents per board foot	3.00
	SMALL EQUIPMENT	
1 Set	Straight shank twist drills, sizes 1/16-inch to $\frac{1}{2}$-inch by 64ths, with stand. Drills of carbon steel	13.00
1	Tapered shank $\frac{3}{4}$-inch drill, carbon steel, number 2 shank	2.00
1	Tapered shank 1-inch drill, carbon steel, number 3 shank	5.50
1	Steel socket for Morse taper shank tools, 3-2	3.20
1 Set	Pipe taps, $\frac{1}{8}$ inch, $\frac{1}{4}$ inch, $\frac{3}{8}$ inch and $\frac{1}{2}$ inch	5.80
1	Tap wrench No. 2	2.50
1 Set	Pipe dies with stock to thread pipe, $\frac{1}{8}$ inch, $\frac{1}{4}$ inch, $\frac{3}{8}$ inch and $\frac{1}{2}$ inch	7.00
1 Set	Taps and dies, machine screw sizes: 4-36, 6-32, 8-32, 10-24, 13-24, set complete with stock and tap wrench in box	8.00
1	Grinding wheel dresser, steel wheel type	.75
1 Set	"V" blocks and clamp	1.85
1 Set	Center punches, 1/16 inch to $\frac{1}{4}$ inch, in case	2.30
1 Pair	Tool maker's parallel clamps, 4-inch jaw	3.00
1 Pair	Tool maker's parallel clamps, 3-inch jaw	2.40
1 Set	N. C. taps and dies: $\frac{1}{4}$ inch-20, $\frac{3}{8}$-16, $\frac{1}{2}$-13, $\frac{5}{8}$-11, tap wrench and stock	23.00

Quantity	*Name and Description*	*Approximate Unit Price*
1	Screw driver, 4-inch blade, hard composition handle..	$.25
1	Screw driver, 6-inch blade, hard composition handle..	.27
1	Screw driver, 8-inch blade, hard composition handle..	.30
12	Copper plated steel oilers, ½ pint capacity	.14
1 Doz.	File handles, number 2	.43
1	Pipe wrench 6 inches	.75
1	Pipe wrench 12 inches	1.10
1	Monkey wrench 11 inches	.50
1	"S" wrench, 6-inch adjustable	.50
1	"S" wrench, 12-inch adjustable	1.35
12	Combination center drills and countersinks	.67
2	Combination squares with center head and scale, 12 inches	4.00
1	Bevel protractor for 12-inch scale	6.10
1	Combination depth and angle gage	2.25
1	Surface gage, 3-inch base, 9-inch spindle	3.50
2	Micrometer calipers, range 0-1 inch, measurements by .001 inch	10.00
1 Set	Consisting of 6 micrometer calipers with range in size from 1 inch to 6 inches with case	71.25
3	Center gages for testing center of lathe and setting tool	.40
1 Pair	Calipers, 4 inches inside, spring nut	1.20
1 Pair	Calipers, 4 inches outside, spring nut	1.20
1 Pair	Dividers, 4 inches, spring nut	1.20
1 Pair	Calipers, 6 inches inside, spring nut	1.65
1 Pair	Calipers, 6 inches outside, spring nut	1.65
1 Pair	Dividers, 6 inches, spring nut	1.65
1 Pair	Hermaphrodite calipers, 6 inches	.70
3	Scribers, handle, ¼ inch; blade, 2⅜ inches.....	.35
1	Positive stop thread gage for N. C. & N. F. threads	1.80

COLD IRON—3 STUDENTS

Large Equipment

1	All steel table 29¼ inches x 10 inches x 33¼ inches high	51.20

Small Equipment

3	Machinist's vises, 4½-inch jaw, 7-inch opening	12.40
2	Universal bench anvils for bending cold iron	11.00
2	Ball pein hammers, 8 ounces handled	.60
1	Ball pein hammer, 12 ounces handled	.60
1	Cast iron cutting block	10.00
1	Ball pein hammer, 16 ounces handled	.70
1	Ball pein hammer, 20 ounces handled	.75
1	Pistol grip adjustable frame hack saw; 8-inch—12-inch blades	1.75
1	Hand drill	2.75
2	Cold chisels, ⅜ inch	.38
2	Cold chisels, ½ inch	.42
2	Cold chisels, ¾ inch	.67
2	Cold chisels, 1 inch	1.05
1	Cape chisel, ½ inch x ¼ inch	.45
1	Round nose chisel, ½ inch x ¼ inch	.45
1	Diamond point chisel, ½ inch x ¼ inch	.45
1	Diamond point chisel, ¾ inch x ½ inch	.72
2	Mill second cut files, 10 inch	.40

Quantity	*Name and Description*	*Approximate Unit Price*
2	Mill smooth cut files, 10 inch	$.35
2	Hand file, bastard, 10 inch	.35
1	Three-square second cut tapered, 10 inch	.43
1	Round, bastard, 8 inch	.46

WELDING—3 STUDENTS

Machines and Accessories

1	Arc welder, transformer type, 20—120 amperes, 110 or 220 volts, 60-cycle current. To include: welder's helmet, electrode holder, hand shield, 2 power lines to welder cable, from welder to welding table	78.45
1	Spot welder, to be constructed. Materials for construction	15.00

Large Equipment

1	Welder's bench	32.70

Small Equipment

1	Scratch brush	.25
1 Pair	Heavy gauntlets	2.00
1	Cutting torch	25.00
1	Welding torch (approved by Underwriters) single tube extension torch, equal pressure, non-flash, 5-copper welding tips	22.50
1	Torch lighter	.50
1	Oxygen regulator with safety gages	16.25
1	Acetylene regulator with safety gages	21.00
1	Adaptor to connect acetylene regulator to cylinders	1.50
1	Wrench	.75
2	Lengths of hose, 1 for oxygen, 1 for acetylene	3.00
1 Pair	Goggles	2.00
1	Instruction book	1.00

ART METAL—3 STUDENTS

Machines and Accessories

1	Buffer, $\frac{1}{4}$ H. P., 110-volt, 60-cycle, A. C., 3500—1700..	60.00
	Accessories for buffer: Including polishing outfit. Polishing outfit to include, 1 of each of the following:	
1	Lathe splasher	1.50
1	Polishing outfit to include: (1 of each of the following)	
	Walrus wheel, 4 inches x 1 inch	
	Sheepskin buff, 4 inches x 1 inch	
	White Spanish felt wheel, 3 inches x $\frac{3}{4}$ inch	
	Black bristle saucer brush, $3\frac{1}{2}$ inches x $\frac{1}{4}$ inch	
	Steel scratch brush, $3\frac{1}{2}$ inches diameter	
	Brass wire brush wheel, $3\frac{1}{2}$ inches diameter	
	Black bristle cup brush, $1\frac{7}{8}$ inches—2 rows	
	Upright black bristle brush, $3\frac{1}{2}$ inches diameter	
	Muslin buff, 4 inches x 1 inch	
	Cotton flannel buff, 4 inches x $\frac{3}{4}$ inch	
	Converging black bristle brush, $3\frac{1}{2}$ inches	
	Cotton goblet brush, $2\frac{1}{2}$ inches x $2\frac{1}{4}$ inches	
	Bristle goblet brush, 3 inches	10.25

Quantity	*Name and Description*	*Approximate Unit Price*
	SMALL EQUIPMENT	
1	Oblong pitch pan with 4 pounds of pitch	$1.35
1	Enameling muffle gas furnace, 3½ inches x 6 inches x 9 inches	85.00
1 Set	Chasing tools	8.00
1 Set	Stake and anvil heads with holders	18.00
4	Machinist's vises, 4½-inch jaw x 7½-inch opening with stationary base and copper jaw plates	13.00
1	Silversmith's hammer, handled	2.10
1	Embossing hammer, handled	2.10
1	Raising hammer, handled	1.80
2	Planishing hammers	2.10
1	Embossing mallet with two tapered ends	.50
1	Embossing mallet with round end forming head	.80
1	Embossing mallet, wedge faced	.60
2	Sand bags	2.00
1 Set	Roundhandled Swiss pattern needle files, 5½-inch length	3.50
1	Jeweler's saw frame, deep throat	1.10
1	Jeweler's saw frame, adjustable, 4-inch throat	.75

FOUNDRY—2 STUDENTS

LARGE EQUIPMENT

1	Molder's bench, 45 board feet of lumber at $.10 per board foot	4.50
1	Melter, floor type gas furnace for melting aluminum, brass, copper, etc., with floor leg, gas burner, and blower. Forty cubic inch crucible capacity	72.00

SMALL EQUIPMENT

1	Bulb sponge, ½ pint capacity	.90
1	Strike off bar	.95
1	Parting sand duster	1.00
1	Shovel	2.25
2	Wire foundry riddles, 16 inches	1.50
1	Bellows, 8 inches	1.65
1	Gate stick	.27
1	Ladle, 6 inches	1.50
2	Bench rammer, 3½ inches x 13 inches	1.25
1	Sprinkler, 14 quart capacity	1.00
2 Pairs	Molder's goggles	1.50
1 Pair	Molder's gloves	1.50
8 Sets	Flask pins	1.05
8 Sets	Flask guides	1.20
4	Flasks, 12 board feet of oak for each	.50
12	Sand crucibles, 3½ inches x 4⅞ inches x 6 inches high	.45
1	Wire brush	.25
2	Gate cutters	.65
1	Slick and oval	.65
1	Heart and leaf tool	.65
1	Slick and square	.65
1	Lifter, ⅛ inch x 12 inches	.60
1	Brass spue cutter, ¾ inch x 10 inches	.50
1	Finishing trowel, 1¼ inch x 6 inches	.90
2	Square trowel, 1¼ inch x 6 inches	.90

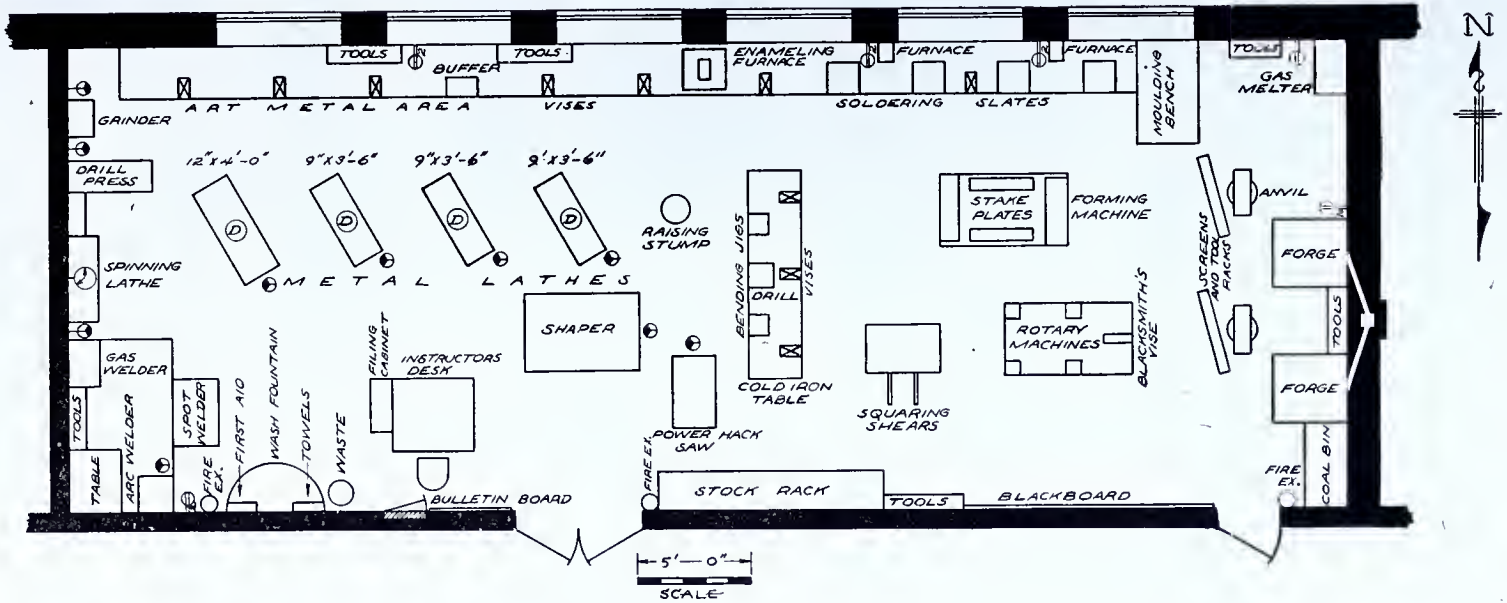
Quantity	*Name and Description*	*Approximate Unit Price*
	LARGE EQUIPMENT	
2	Forges, one-piece steel hearth, half hood, hearth—24 inches x 30 inches x 6 inches deep, complete with blower, motor, switch, speed regulator, and water tank	$65.00
2	Anvils, 100 pounds	16.00
1	Steel leg vise, $4\frac{1}{8}$ inches jaw, $4\frac{1}{2}$ inches opening	10.75
1	Coal bin, 40 board feet of lumber at 10 cents per board foot	4.00
1	Blacksmith forge and shop rack	67.50
1	Spark screen, 6 feet x 8 feet, with $\frac{1}{4}$-inch mesh screen	10.00
	SMALL EQUIPMENT	
1	Cross pein hammer, 8 pounds handled	2.10
1	Straight pein hammer, 8 pounds handled	2.10
2	Blacksmith's hammers, 2 pounds handled	.84
2	Blacksmith's hammers, 3 pounds handled	1.14
2	Swages, 1 top and 1 bottom, $\frac{1}{2}$ inch	1.21
2	Fullers, 1 top and 1 bottom, $\frac{1}{2}$ inch	1.25
2	Handles, for top swage and top fuller	.30
1	Anvil hardie, $2\frac{1}{2}$ inches	.91
1	Square punch, $\frac{1}{2}$ inch	.90
1	Round punch, $\frac{1}{2}$ inch	.96
1	Square flatter, $2\frac{1}{4}$ inches square	1.82
1	Cold cutter, $1\frac{1}{2}$ inches	1.38
1	Hot cutter, $1\frac{1}{2}$ inches	1.38
5	Handles, 16 inches, for punches, flatter, and cutters	.30
1 Pair	Blacksmith's tongs, straight lip, 18 inches	1.00
1 Pair	Blacksmith's tongs, curved lip, bolt $\frac{1}{2}$ inch, 20 inches long	1.00
1 Pair	Blacksmith's tongs, curved lip, bolt $\frac{3}{8}$ inch, 20 inches long	1.00
1 Pair	Blacksmith's tongs, gad 18 inches	1.00
1 Pair	Blacksmith's tongs, pick up 22 inches	1.00

METAL SPINNING—1 STUDENT

MACHINES AND ACCESSORIES

1	Wood turning lathe built with special bearings to withstand metal spinning. 15-inch swing	350.00
1	Spinning accessories for above lathe:	
1	Large face plate, $5\frac{3}{4}$ inches for 15-inch lathe	10.50
1	Ball bearing back center to fit above lathe	25.00
1	"T" rest, 14 inches	6.00
3	Spinning pins, $2\frac{7}{8}$ inches	.35
	SMALL EQUIPMENT	
1	Goose neck spinning tool	4.75
1	Goose neck tool with ball point	5.85
1	Flat tool	6.25
1	Pointed tool	3.00
1	Ordinary ball tool	6.25
1	Necking tool	4.75
1	Large burnishing tool	5.75

Quantity	*Name and Description*	*Approximate Unit Price*
1	Beading roller, 5/16-inch groove	$6.25
1 Pair	Spinning pliers	4.50
1 Pair	Spinner's goggles	2.00
1 Set	Turning tools, blades, 6 inches; handles, 9½ inches; Set to include: ½-inch parting tool, ½-inch diamond point, ½-inch round point, ¼-inch chisel, ¼-inch gouge, ½-inch gouge, ¾-inch gouge, 1-inch chisel, (skew)	8.00
1	Spur center for 15-inch lathe	1.10
1	Cup center for 15-inch lathe	1.10
1	Hand rest for 15-inch lathe	2.50
1	Rack for spinning tools, 11 board feet lumber at $.10	1.10
	MISCELLANEOUS	
1	Teacher's desk, double pedestal type wood construction	22.75
1	Teacher's chair, swivel with arms	11.00
1	Filing cabinet, steel construction, 4 drawers, 24 inches deep, 14⅜ inches wide, 54 inches high	33.00
1	Steel waste basket, 18 inches diameter, 24 inches high	3.75
1	Covered waste can with foot treadle	4.00
1	Paper towel cabinet	1.00
1	Cork bulletin board, 36 inches x 48 inches	8.50
1	First aid cabinet with mirrored door and supplies	6.50
1	Wash fountain, 54 inches, semi-circular	145.00
1	Metal stock rack, 2 pedestal, single arm	100.30
5	All-steel benches, 33½ inches high, 23¾ inches wide, 10 feet long	42.20
1	Tool cabinet, 32 board feet of lumber at $.10 per board foot	3.20



SUGGESTED FLOOR PLAN FOR A SENIOR HIGH SCHOOL INDUSTRIAL ARTS METAL SHOP

22'—0" x 60'—0"

SHOP TO ACCOMMODATE 24 STUDENTS AS, FOLLOWS.

MACHINE SHOP — 5 FOUNDRY — 2 WELDING — 3 SHEET METAL — 4

FORGE WORK — 2 COLD IRON — 3 ART METAL — 4 SPINNING — 1

SUGGESTED EQUIPMENT SPECIFICATIONS FOR THIS SHOP BEGIN ON PAGE

3. Woods—Junior High School.[3]

The fact should be borne in mind that for some students enrolled in this wood shop the values of the experiences gained will be pre-vocational; for all students, however, the values will be of a general educational nature. This shop is not designed to furnish vocational preparation.

The storage space indicated on the floor plan is not the total amount available, inasmuch as it is possible to provide space under the lumber rack, and under the utility table. In addition, some of the smaller unfinished individual work can be stored in the student lockers throughout the building. Furthermore, each double bench is equipped with twelve half-width drawers which may be used for the storage of unfinished work.

A jig saw has been specified in preference to a band saw for reasons of economy and safety. Due to crystallization of blades, experts seem to agree that a band saw with wheels of less than twenty-inch diameter is not desirable. A twenty-inch band saw will cost at least $300.00. A jig saw has the combined advantages of low cost blades, portability, relatively low first cost, inherent safety, and the possibility of using it to cut out center designs, leaving the rim intact. At the same time it offers ample capacity for a junior high school wood shop.

It is felt that it will seldom be necessary to work stock greater than ten feet in length; but in cases where it becomes necessary, the door opening into the corridor at the rear of the variety saw may be opened and the stock extended into the corridor to facilitate sawing. The jig saw, being portable, may be moved out of line to enable the jointing of stock longer than eight feet on the jointer.

If an available budget for a wood shop is not sufficient to provide for the purchase of all the suggested items, some economies can be effected by carrying out at least some of the following suggestions:

1. Substitute sinks for wash fountain.
2. Substitute portable dry grinder for multiple grinder.
3. Specify both lathes to be of a portable type.
4. Reference shelf, lumber rack, clamp rack, gluing bench, finishing table, saw horses, and storage cabinets might be constructed in the shop.

Whatever is done with respect to deleting certain items, or substituting for others, it is felt that the teacher who is responsible for setting up and administering the course of study should be fully consulted beforehand.

[3] Explanatory notes to be used as reference in considering the suggested floor plan and equipment specifications for a junior high school industrial arts wood shop, twenty-two feet by sixty feet, to accommodate twenty-four students.

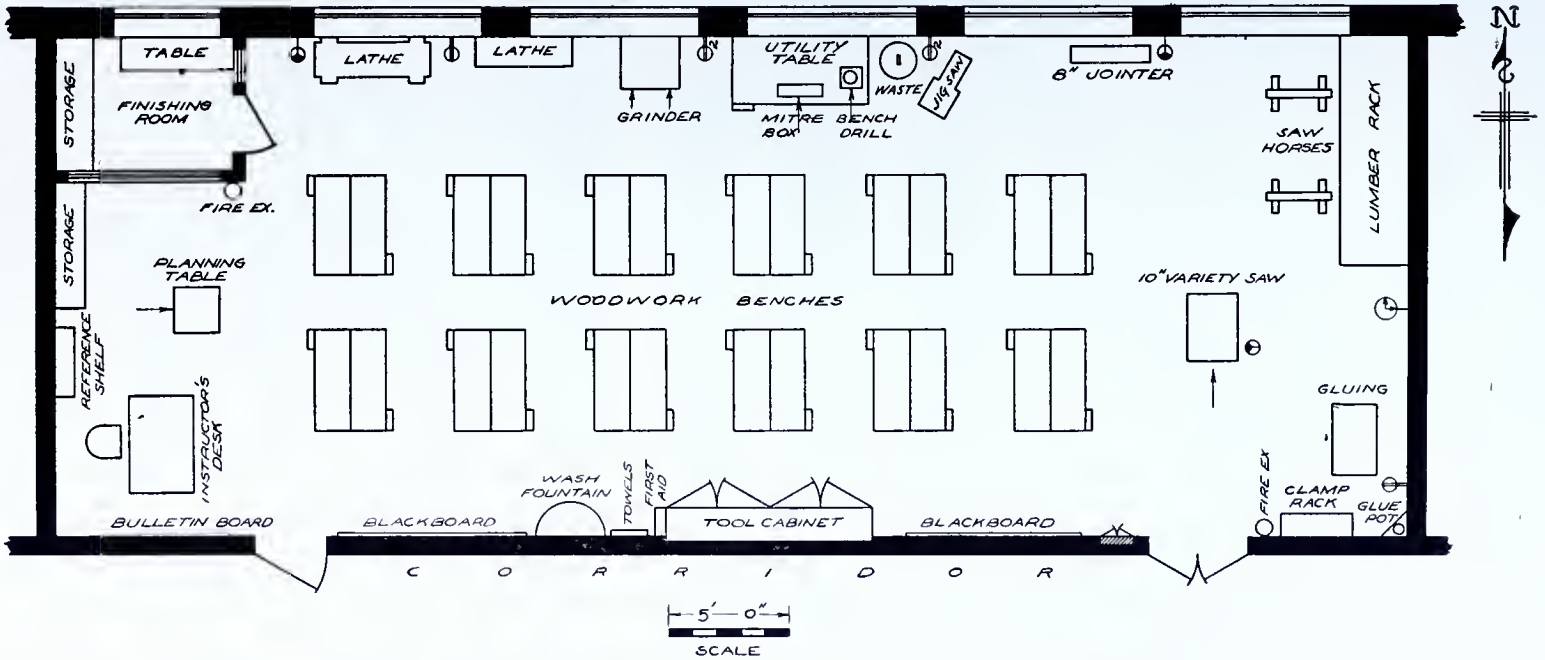
SUGGESTED EQUIPMENT SPECIFICATIONS FOR A JUNIOR HIGH SCHOOL INDUSTRIAL ARTS WOOD SHOP. 22 FEET X 60 FEET. SHOP TO ACCOMMODATE 24 STUDENTS

Quantity	*Name and Description*	*Approximate Unit Price*
	WOOD SHOP	
1	Saw, variety, tilting arbor, 10-inch blade, direct motor drive, 110-220 volts; including one 10-inch rip saw, one 10-inch cross-cut, and one 6-inch dado head complete	$158.75
1	Lathe, 38 inches, between centers, direct motor drive. Standard equipment: one ⅝-inch cup; one 1-inch spur center, one 6-inch tool rest, one 12-inch tool rest, one rear tool shelf, one 8-inch rear face plate and hand wheel, one 6-inch face plate, one 3-inch rosette chuck, one blueprint holder, one center drift rod, one square hollow chuck, one face plate wrench	350.00
1	Lathe, 31 inches between centers, 14-inch swing, motor drive, variable speed, tailstock, ball bearing; built-in spindle indexing device, 6-inch and 12-inch tool rests; 4-inch face plate, ¼-inch spur center, ½-inch cup center. Lathe equipped with 1/3 H. P., 110-volt, 60-cycle, single phase, split phase ball bearing motor	57.50
1	Floor type base for above lathe	22.00
1	Floor stand for tool supports, for turning face plate work on left end of spindle. Heavy cast tripod legs, cast tool support	8.50
1 Set	Turning tools:	
1	¼-inch gouge, 6-inch blade, 9½-inch handle	.95
1	½-inch gouge, 6-inch blade, 9½-inch handle	1.15
1	¾-inch gouge, 6-inch blade, 9½-inch handle	1.30
1	½-inch parting tool, 6-inch blade, 9½-inch handle	1.00
1	½-inch round nose, 6-inch blade, 9½-inch handle	.90
1	½-inch diamond point, 6-inch blade, 9½-inch handle	.90
1	¼-inch skew, 6-inch blade, 9½-inch handle	.80
1	1-inch skew, 6-inch blade, 9½-inch handle	1.30
1	Jointer, 8 inches; table length, 4 feet; width 8 inches; height, 31½ inches. ¾ H. P. Three knives on cutterhead, adjustable fence tilts to 45 degrees. Speed of cutterhead 3600 R.P.M.	185.00
1	Grinder, motor driven variety oilstone. Two 2-inch face oilstone wheels; one coarse, one fine grain	195.00
1	Router, electric, ⅜ H.P. ¼-inch chuck capacity, up to ⅝-inch cuts, 5/16-inch deep	68.00
1	Sander, portable belt type, dustless. 110-volt	145.00
1	Jig saw, 24-inch clearance, variable speed, motor drive, 6-inch blade, table tilts to 45 degrees	38.50
1	Stand for above jig saw, heavy bench with cast iron legs	10.95
1	Glue pot, electric, 2-qt. capacity. 110-220 volt. Thermostatic heat control	18.50
1	Electric bench drill ½-inch. Equipment as follows: combination spade and breast plate handle, 3 jawed geared chuck, conductor cable and plug. Overall length 16⅝ inches, universal type motor, operates on AC or DC, 110-volt	53.00
1	Bench drill stand for above	22.00

Quantity	*Name and Description*	*Approximate Unit Price*
	LARGE EQUIPMENT	
12	Woodworking benches, double, 2 large drawers, 12 small drawers, maple construction, 2 continuous screw vises, 2 dogs, top size 52 inches x 36 inches..	$75.00
1	Lumber rack and project storage rack, to be constructed. 160 board feet yellow pine, 70 board feet 3-ply ¼-inch fir panel 80 square feet	20.00
1	Clamp rack, 36 board feet yellow pine	2.40
1	Bulletin board, 25 inches x 36 inches	6.00
	SMALL EQUIPMENT (HAND TOOLS)	
12	Back saws, 10-inch length, 2¼-inch back. 12 points to inch, 22 gauge	1.80
3	Rip saws, 26-inch length, 7 points to inch	3.25
4	Cross-cut saws, 26-inch length, 10 points to inch	3.25
6	Coping saw frames, 6½-inch blade, depth of frame 4½-inch	.85
2	Dove-tail saws, 8-inch blade, 1½-inch under back..	1.85
1	Compass saw, 10-inch blade, 8 points to inch	1.10
24	Jack planes, 14-inch long, 2-inch cutter.....	4.50
24	Block planes, 6-inch length, 1⅝-inch cutter	2.10
1	Smooth plane, 9-inch length, 2-inch cutter	2.50
2	Jointer plane, 22-inch length, 2⅜-inch cutter.....	8.30
2	Spoke shaves, 10-inch length, 2⅛-inch cutter.....	.85
4	Hand scrapers, 4-inch length, 3-inch width	.45
2	Cabinet scrapers, double handle, 2¾-inch blade, 11¾-inch long	1.25
6	Bit braces, 10-inch swing, ratchet handle	4.20
2	Bit braces, 8-inch swing	2.10
2	Hand drills, capacity ¼-inch, 3½-inch speed gear....	3.80
2	Automatic push drills, 8 drill points, 1/16-inch to 11/64-inch	2.44
3	Countersink bits, rose type, ¾-inch cutting edge....	.45
3	Countersink bits, rosette type, ¾-inch.....	.45
1	Expansive bit, ⅝-inch to 1¾-inch capacity.....	1.85
2	Auger bit set, bit sizes 4 to 16 double leadscrew....	8.05
4	Bit gauges, 2-inch length.....	.60
2	Dowel sharpener bits, 3-inch length.....	.50
2	Doweling jig, 9 guides, ¼-inch, 5/16-inch, ⅜-inch, 7/16-inch, ½-inch, 9/16-inch, ⅝-inch, 11/16-inch, ¾-inch	4.40
1	Stubby screwdriver, 1¾-inch blade.....	.55
6	Screwdrivers, diameter of handle 9/32-inch, 4-inch blade	Doz. 5.40
6	Screwdrivers, diameter of handle 5/16-inch, 6-inch blade	Doz. 7.50
1	Screwdriver, diameter of handle ⅜-inch, 8-inch blade.	Doz. 9.60
6	Hammers, 16-ounce claw hammers	.70
4	Hammers, 10-ounce claw hammers	.65
24	Try squares, rosewood handle, 6-inch blade, 4½-inch handle	.65
2	Try squares, rosewood handle, 10-inch blade, 6⅝-inch handle	1.15
3	T bevels, 8-inch blade	.55
2	Framing squares, plated body 2 inches x 2 inches, tongue 16 inches x 1½ inch	1.63

Quantity	*Name and Description*	*Approximate Unit Price*
24	Steel bench rules, $\frac{3}{4}$ inch x 24 inches	$.82
24	Marking gauges, brass thumb screw and plate	.95
1	6-foot zig-zag rule	.50
12	Nail sets, two each of the following: 1/32-inch, 1/16-inch, 3/32-inch, 4/32-inch, 5/32-inch, 5/64-inch	1.10
3 Pairs	Spring dividers, 8 inches	1.15
3 Pairs	Calipers, outside, 8 inches (friction)	1.02
3 Pairs	Calipers, inside, 8 inches (friction)	1.02
1	Scraper burnisher	.85
6	Sloyd knives, $3\frac{1}{8}$-inch blade	.30
4	Half round cabinet wood files, 12 inches long	1.60
4	10-inch flat wood files	.40
1	7-inch auger bit file	.35
2	Wood rasp, half round cabinet, 10 inches (bastard)	.64
6	Mallets, hickory, $2\frac{1}{2}$ inches x $5\frac{1}{2}$ inches	.30
2	Mallets, rubber, $2\frac{1}{4}$ inches x 4 inches	.64
2	Putty knives, stiff blade, width of blade $1\frac{1}{4}$ inch, $3\frac{5}{8}$ inches long	.25
	Clamps, steel bar	
6	3 feet I—B	2.00
4	4 feet I—B	2.50
4	6 feet I—B	3.00
9	Hand screws, 10-inch jaw opening	1.30
9	Hand screws, 6-inch jaw opening	.95
	Chisels	
1	Pocket, blade $4\frac{1}{2}$ inches long, width $\frac{1}{8}$ inch overall $9\frac{1}{8}$ inches	1.40
2	Pocket, blade $4\frac{1}{2}$ inches long, width $\frac{1}{4}$ inch, overall $9\frac{1}{8}$ inches	1.40
2	Pocket, blade $4\frac{1}{2}$ inches long, width $\frac{3}{8}$ inch, overall $9\frac{1}{8}$ inches	1.40
3	Pocket, blade $4\frac{1}{2}$ inches long, width $\frac{1}{2}$ inch, overall 9 5/16 inches	1.45
1	Pocket, blade $4\frac{1}{2}$ inches long, width $\frac{5}{8}$ inch, overall 9 5/16 inches	1.50
3	Pocket, blade $4\frac{1}{2}$ inches long, width $\frac{3}{4}$ inch, overall $9\frac{1}{2}$ inches	1.55
1	Pocket, blade $4\frac{1}{2}$ inches long, width $\frac{7}{8}$ inch, overall $9\frac{1}{2}$ inches	1.65
1	Pocket, blade $4\frac{1}{2}$ inches long, width 1 inch, overall $9\frac{5}{8}$ inches	
12	Brush holders, consisting of a rubber cap which fits snugly the top of a Mason jar. The cap has a flexible hole in the center, designed to grip a brush handle and hold the brush in the liquid	Doz. .90
	Brushes, flat varnish brushes	
2	Size $\frac{1}{2}$ inch; length of bristle $1\frac{5}{8}$ inches	.10
2	Size 1 inch; length of bristle $2\frac{1}{8}$ inches	.14
2	Size $1\frac{1}{2}$ inches; length of bristle $2\frac{1}{8}$ inches	.37
2	Size 2 inches; length of bristle $2\frac{3}{8}$ inches	.54
1	Size $\frac{3}{4}$ inch; length of bristle $1\frac{3}{4}$ inches	.12
2 Pairs	Combination pliers, 6 inches; capacity 1 inch	.21
1	Hacksaw, adjustable blade, 8 inches—10 inches—12 inches	1.75

Quantity	*Name and Description*	*Approximate Unit Price*
	MISCELLANEOUS EQUIPMENT	
1	Instructor's desk, top 50 inches x 32 inches	$29.40
1	Swivel arm chair	11.40
1	Wastebasket, 14½ inches high, 13-inch top	.75
1	Art Table, for planning, adjustable in height	11.60
1	Wash fountain, semi-circular, 36 inches diameter, liquid soap dispenser	146.50
6	Oil cans, 1/3 pt.; Spout 3 inches	.14
1	Paper towel fixture	1.00
3	File cleaners, metal back	.50
1	Oilstone, 7 inches x 2 inches x ⅝ inch, medium grit	3.78
1 Set	Steel figures, ⅛ inch	.83
1 Set	Steel letters, ⅛ inch	2.48
2 Doz.	Bench dusters, 7 inches, 1⅞ inch trim	Doz. 3.00
1	Oily waste can, with lid, diameter 18 inches, height 24 inches	5.67
1	Glasscutter	.10



SUGGESTED FLOOR PLAN FOR A JUNIOR HIGH SCHOOL INDUSTRIAL ARTS WOOD SHOP
22'—0" x 60'—0"

SHOP TO ACCOMMODATE 24 STUDENTS

SUGGESTED EQUIPMENT SPECIFICATIONS FOR THIS SHOP BEGIN ON PAGE

4. Drawing and Design—Senior High School.[4]

The fact should be borne in mind that for some students enrolled in this drawing and design class the values of the experiences gained will be pre-vocational; for all students, however, the values will be of a general educational nature. This drawing and design room is designed to furnish no vocational preparation.

It is hoped that this drawing and design room will be used for more than just formal mechanical drawing. An appreciational knowledge of the drawing and design side of graphic arts requires experience in freehand sketching, shading and tinting. Furthermore, the drawing and design room should be used to supplement the facilities of the planning areas provided in the various industrial arts shops throughout the school.

Obviously, the fact that less working space is required per student enables us to accommodate many more students in the drawing and design room than would be possible in any shop of equal size.

A set of drawing instruments can be stored in the side drawer in each drawing table. These drawers should be furnished with locks. With reasonably close checking on the part of the teacher, this should prove more efficient than storing the instruments in a separate case of drawers.

No mechanical blueprinting equipment has been specified for the reason that production blueprinting is not encouraged; and because the basic process is sufficiently emphasized through sun printing.

Whatever is done with respect to deleting certain items, or substituting for others, it is felt that the teacher who is responsible for setting up and administering the course of study should be fully consulted beforehand.

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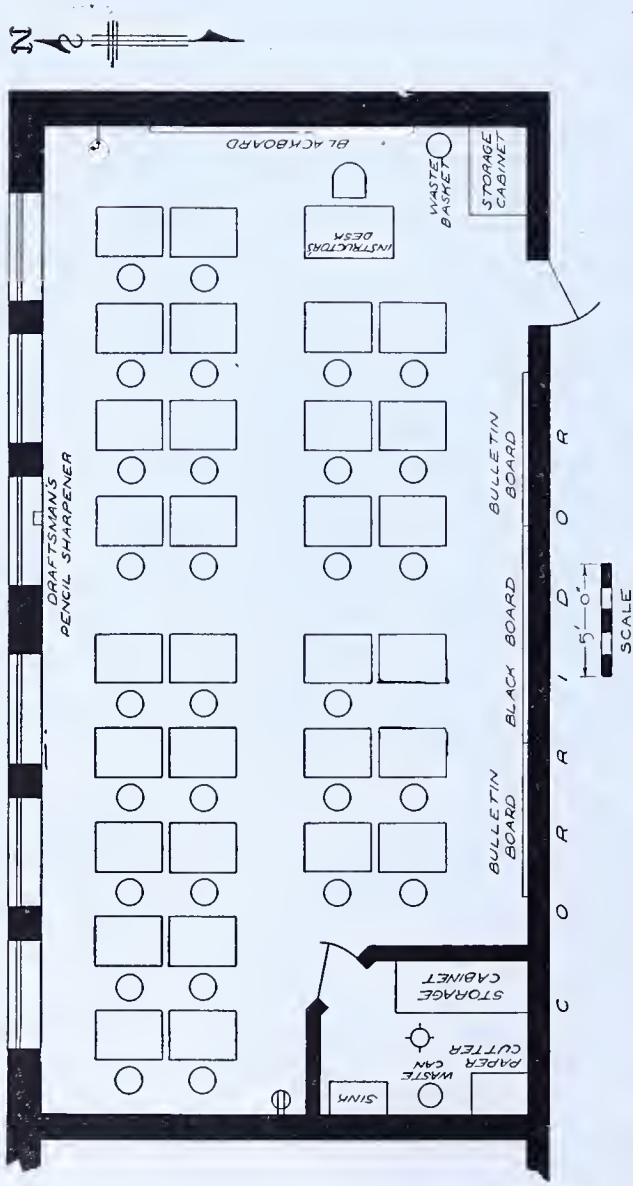
[4] Exploratory notes to be used as reference in considering the suggested floor plan and equipment specifications for a senior high school drawing and design room, twenty-two feet, no inches by forty-five feet, no inches, to accommodate thirty students.

SUGGESTED EQUIPMENT SPECIFICATIONS FOR A SENIOR HIGH SCHOOL DRAWING AND DESIGN ROOM, 22 FEET X 45 FEET.

DRAWING AND DESIGN ROOM TO ACCOMMODATE 30 STUDENTS

Quantity	*Name and Description*	*Approximate Unit Price*
	LARGE EQUIPMENT	
30	Drawing tables 28 inches x 36 inches x 40 inches high; 1-9 inch x 20 inch x 4 inch side drawer with lock on front of table, accommodate six boards up to 20 inches x 26 inches, boards located on right side of desk under drawer, oak body and hardwood top.	$30.00
30	Metal stools, double riveted steel frame, hard wood seat 30 inches high, 13½ inches diameter, olive green finish	2.85
1	Instructor's desk, 4 feet x 30 inches x 30 inches high, quartered oak top and drawer front, 3 drawers, 17⅞ inches x 24 inches x 3½ inches, with book rail	21.50
1	Steel filing cabinet, four legal sized drawers, outside dimensions 17¾ inches x 26½ inches x 51⅛ inches	33.00
1	Table, 2 feet 0 inches, 2 feet 6 inches high, oak construction, cost of material	5.00
1	Storage cabinet, 30 inches x 6 feet x 36 inches high, 6 shelves for paper storage, construction from second grade white pine, cost of materials	10.00
1	Swivel chair	11.45
1	Paper cutter, 18 inches x 18 inches	17.50
1	Blue print frame, 21½ inches x 25½ inches, frame, pad, glass	34.50
2	Developing trays, 30 inches x 42 inches x 6 inches, 19 bd. ft. lumber, lined with terne plate	5.00
1	Blue print frame 11 inches x 16 inches, frame pad, glass	11.00
	SMALL EQUIPMENT	
1	Draftsmen's Pencil Sharpener	2.75
30	Sets drawing instruments, one ruling pen, bow dividers, bow pen, bow pencil, compass 6 inches with lengthening bar, divider part, pen and pencil part, plain dividers, vial repair parts, screw driver with leads, metal handle	8.08
30	Pencil pointers, sandpaper	.30
30	Triangles, 8 inches, 30-60 degrees, transparent	.50
30	Triangles, 8 inches, 45-45 degrees, transparent	.66
30	French curves, 8 inches, transparent	.55
12	Protractors, 8 inches	.20
31	Architects boxwood scales, 12 inches	.60
30	T-squares, 24 inch amber edge	2.50
2	T-squares, 36 inch amber edge	3.25
60	Drawing boards, basswood, 20 inches x 26 inches	1.40
2	Drawing boards, basswood, 31 inches x 42 inches	3.35
30	Eraser shields, nickel plated	.08
1	Pair shears, 12 inch blade	3.20
36	Pen holders, 7 inches medium	.05
1	Protractor, wooden	2.00
1	Compass, wooden	1.00



SUGGESTED FLOOR PLAN FOR A SENIOR HIGH SCHOOL DRAWING AND DESIGN ROOM

22'-0" × 45'-0"

DRAWING AND DESIGN ROOM TO ACCOMMODATE 30 STUDENTS

SUGGESTED EQUIPMENT SPECIFICATIONS FOR THIS DRAWING ROOM

BEGIN ON PAGE

5. General—Junior-Senior High School.[5]

The fact should be borne in mind that for some students enrolled in this general shop the values of the experiences gained will be prevocational; for all students, however, the values will be of a general educational nature. This shop is not designed for vocational preparation.

A down draft forge has been specified for this shop because it is a bit cleaner (as forges go), and because it makes it possible to exhaust the smoke at some remote section of the building—possibly the chimney of the heating plant.

A universal rotary bench machine has been specified in order to eliminate the purchase of several separate sheet metal machines. It should be located on the metal work bench. It was deemed advisable not to specify a heat treating furnace inasmuch as they are costly and because sufficient hardening, annealing, and tempering can be done in connection with the forge.

The likelihood is that such a shop as this would exist in a rural section where gas mains do not exist. Therefore, electric soldering coppers are specified to handle the soldering needs.

Double woodwork benches have been specified, each having twelve half-width drawers. This will partially solve the storage problem. In addition, storage accommodations can be constructed under other work benches. Furthermore, small unfinished individual work might be stored in student lockers throughout the building.

No finishing room has been partitioned off within this shop because of limited space. The application of finishes demanding reasonably dustless conditions will have to be done outside of regular school hours.

If it is likely that the metal work in this shop will ever be expanded to include metal spinning, an economy could be effected by purchasing a portable lathe instead of the standard one specified. A further economy would be the elimination of the wash fountain in favor of conventional wash sinks.

Whatever is done with respect to deleting certain items, or substituting for others, it is felt that the teacher who is responsible for setting up and administering the course of study should be fully consulted beforehand.

[5] Explanatory notes to be used as reference in considering the suggested floor plan and equipment specifications for a junior-senior high school general industrial arts shop twenty-two feet by forty-five feet; to accommodate eighteen students.

SUGGESTED SPECIFICATIONS FOR A JUNIOR-SENIOR HIGH SCHOOL GENERAL INDUSTRIAL ARTS SHOP, 22 FEET X 45 FEET.

Shop to Accommodate 18 Students

WOOD WORK—6 STUDENTS

Quantity	*Name and Description*	*Approximate Unit Price*
	Power Machines and Their Accessories	
1	Saw, variety, tilting arbor, 10-inch blade, direct motor drive, 110-220 volts; including one 10-inch rip saw, one 10-inch cross cut saw, and one 6-inch dado head complete	$158.75
1	Lathe, 38 inches between centers. Standard equipment: one $\frac{5}{8}$-inch cup, one 1-inch spur center, one 6-inch tool rest, one 12-inch tool rest, one rear tool shelf, one 8-inch rear face plate and handwheel, one 6-inch front face plate, one 3-inch rosette chuck, one blueprint holder, one center drift rod, one square hollow chuck, one face plate wrench	350.00
	One set of turning tools for lathe	
1	$\frac{1}{4}$-inch gouge, 6-inch blade, $9\frac{1}{2}$-inch handle	.95
1	$\frac{1}{2}$-inch gouge, 6-inch blade, $9\frac{1}{2}$-inch handle	1.15
1	$\frac{3}{4}$-inch gouge, 6-inch blade, $9\frac{1}{2}$-inch handle	1.30
1	$\frac{1}{2}$-inch parting tool, 6-inch blade, $9\frac{1}{2}$-inch handle	1.00
1	$\frac{1}{2}$-inch round nose, 6-inch blade, $9\frac{1}{2}$-inch handle	.80
1	$\frac{1}{2}$-inch diamond point, 6-inch blade, $9\frac{1}{2}$-inch handle	.90
1	$\frac{1}{4}$ inch skew, 6-inch blade, $9\frac{1}{2}$-inch handle	.80
1	1-inch skew, 6-inch blade, $9\frac{1}{2}$-inch handle	1.30
1	Drill, electric. Bench drill press. $\frac{7}{8}$-inch drilling capacity. Speed—no load 375 RPM. Full load 185 RPM	53.00
1	Stand for drill press	22.00
1	Grinder, motor driven variety oilstone. Two 2 inch face oilstone wheels; one coarse grain, one fine grain. One $\frac{3}{4}$-inch face emery wheel	195.00
1	Router, electric $\frac{3}{8}$ H.P. $\frac{1}{4}$ chuck capacity, up to $\frac{3}{8}$ inch cuts 5/16 inch deep	68.00
1	Saw, jig. 24 feet clearance, direct drive, 6-inch blades, table tilts to 45 degrees	38.50
1	Stand for jig saw, heavy bench with cast iron legs	10.95
1	Sander, portable belt-type. 110 volt. I H.P. dustless	145.00
1	Glue Pot, electric, 2 qt. capacity, 110 or 220 volt, thermostatic heat control	18.50
	Large Equipment	
3	Woodworking benches, double, 2 large drawers, 12 small drawers, maple construction, 2 continuous screw vises, 2 dogs; top size, 52 inches x 36 inches.	75.00
1	Lumber rack and project storage rack, to be constructed. 80 bd. feet, yellow pine, 3-ply $\frac{1}{4}$-inch fir panel 80 sq. ft.	10.00
1	Clamp rack, 12 bd. ft. yellow pine	.80
1	Bulletin board 24 inches x 36 inches	6.00
	Small Equipment (Hand Tools)	
6	Back saw, 10-inch length, $2\frac{1}{4}$-inch underback. 12 points to inch—22 gauge	1.80
1	Rip saw, 26-inch length, 6 points to inch	3.25

Quantity	*Name and Description*	*Approximate Unit Price*
2	Cross cut saw, 26-inch length, 8 points to inch	$3.25
3	Coping saw, 6½-inch blade, depth of frame 4½ inches.	.75
12 Doz.	Coping saws blades, 15 teeth per inch, pin and loop type	Doz. .45
1	Compass saw, 10-inch blade—8 points to inch	1.10
6	Jack plane, 14 inches long, 2 inch cutter	4.60
6	Block plane, 6 inches long, 1⅝ inch cutter	2.10
1	Jointer plane, 22 inches long, 2⅜ inch cutter	8.30
2	Spokeshave, raised handle, length 10 inches, cutter 2⅛ inches	.85
4	Hand scraper, width 3 inches, length 4 inches	.45
2	Bit brace, 10-inch sweep, ratchet type	4.20
1	Expansive bit, 2 cutters boring from ⅞ inch to 3 inches	1.28
1 Set	Auger bits slow feed, 13 bits, size from ¼ inch to 1 inch by 16ths.	7.50
1	Doweling jig, 5 guides, ¼ inch, 5/16 inch, ⅜ inch, 7/16 inch, ½ inch	2.75
2	Dowel sharpener, 3 inches long	.50
1	Hand drill, ¼ inch capacity, 3½ inch speed gear	3.80
2	Automatic push drill, 8 drill points from 1/16 to 11/64 inch	2.44
3	Countersink bit, rose type, cutting edge ¾ inch	.29
4	Screwdriver, blade 4 inches	.40
2	Screwdriver, blade 6 inches	.77
1	Screwdriver, blade 1¾ inches	.15
1	Pocket chisel, blade 4½ inches long, width ⅛ inch, overall 9⅛ inches	1.40
1	Pocket chisel, blade 4½ inches long, width ¼ inch overall 9⅛ inches	1.40
1	Pocket chisel, blade 4½ inches long, width ⅜ inch, overall, 9⅛ inches	1.40
1	Pocket chisel, blade 4½ inches long, width ½ inch, overall 9⅛ inches	1.45
1	Pocket chisel, blade 4½ inches long, width ⅝ inch, overall 9⅛ inches	1.50
1	Pocket chisel, blade 4½ inches long, width ¾ inch, overall 9⅛ inches	1.55
1	Pocket chisel, blade 4½ inches long, width ⅞ inch, overall 9⅛ inches	1.65
1	Pocket chisel, blade 4½ inches long, width 1 inch, overall 9⅛ inches	1.65
2	Hammer, claw, 16 oz.	.70
2	Hammer, claw, 10 oz.	.65
8	Try squares, blade 6 inches, handle 3½ inches	.61
1	Square, body 12 inches x 1½ inches, tongue 8 inches x 1 inch, steel plated	.76
1	Square, body 24 inches x 2 inches, tongue, 16 inches x 1½ inches, steel plated	1.63
3	T bevel, 8 inch blade	1.61
8	Steel bench rule, ¾ inch x 12 inches, 64th and 32nd graduations	.82
8	Marking gauge, brass thumb screw and plate	.95
3	Files—10 inches, ½ round cabinet wood file	.64
2	Files—10 inches, ½ round cabinet rasp—bastard	.84
1	File—10 inches, flat wood	.30
1	File—13 inch round, bastard cut	.40
8	File handles for 10 inches to 12 inches	.08

Quantity	*Name and Description*	*Approximate Unit Price*
8	Nail sets 1/32, 3/32, 5/64, 4/32 (2 each)	$.12
2 Pairs	Calipers: outside 4 inches, spring nut	Pr. .90
2 Pairs	Calipers: inside 4 inches, spring	Pr. .90
1 Pair	Dividers 6 inches	Pr. 1.05
	Steel bar	
4	3-foot I-bar	2.32
3	4-foot I-bar	2.61
3	6-foot I-bar	3.19
4	Hand screws 10-inch jaws, 6-inch opening, adjustable	1.44
4	Hand screws 7-inch jaws, 3½-inch opening, adjustable.	1.08
2	Putty knife	.30
1	Oilstone, 7 inches x 2 inches x ⅝ inch	3.78
12	Bench duster, 8 inch, 2 inch trim	.33
1	Glasscutter	.20
1 Doz.	Brush holder, consists of a rubber cap which fits snugly the top of a Mason jar. The cap has a flexible hole in the center designed to grip a brush handle and hold the brush in the liquid	Doz. 90
	Flat varnish brushes:—	
2	½ inch, length of bristles 1⅝ inches	.10
2	1 inch, length of bristles 2⅛ inches	.14
2	1½ inches, length of bristles 2⅛ inches	.37
1	2 inch, length of bristles 2⅜ inches	.54
1	All steel finishing bench 60 inches x 29¼ inches x 21⅜ inches	60.00

METAL WORK—7 STUDENTS

Power Machines and Their Accessories

1	Lathe, bench, motor drive, ¼ H.P. Swing over bed, 9-inch bed, length 3 feet	150.00
1	Chuck, fitted, 6-inch jaw independent	25.00
1	Chuck, fitted, 6 inches—3-jaw universal	25.00
1	Chuck, fitted, drill, ½-inch capacity	7.00
2	Tool holder, straight shank, 5/16 inch x 5/16 inch	2.50
1	Tool holder, right hand, 5/16 inch x 5/16 inch	2.50
1	Tool holder, left hand, 5/16 inch x 5/16 inch	2.50
1	Tool holder, boring, ½-inch dia. bar	3.00
1	Tool holder, bent, cutting off, ⅛-inch cutter	2.50
3	Lathe Dogs, Safety, 2 each ½ inch, ¾ inch, 1 inch, 1¼ inches	.75
1	Forge, downdraft, electric steel, 110 volt, 30 inches x 36 inches	79.70
1	Spark screen, 6 feet height, 8 feet long, to be constructed	10.00
1	Anvil, 100 lb.	30.00
1 Pair	Forge tools: straight lipped blacksmith tongs 20 inches long	1.02
1 Pair	Gad tongs 21 inches long	1.17
1 Pair	Pickup tongs 18 inches long	1.30
1 Pair	Curve lipped blacksmith tongs 20 inches long	1.17
1	Blacksmith's sledge, 16-inch handle, 3 lbs.	.80
1	Blacksmith's sledge, 16-inch handle, 2½ lbs.	.65
1	Blacksmith's sledge, 16-inch handle, 2 lbs.	.52
1	Round punch, ¼ inch	.92
1	Square flatter, 2 inch	1.30
1	Hot cutter, cutting edge 1½ inch	1.30

Quantity	*Name and Description*	*Approximate Unit Price*
1	Anvil hardie, 2-inch width 2-inch width bit	$.79
3	16-inch handles for round punches, flatter and hot cut	.30
1	Bottom fuller, $\frac{1}{2}$ inch	1.20
1	Top fuller, $\frac{1}{2}$ inch	1.20
1	Top swage, $\frac{3}{4}$ inch	1.20
1	Bottom swage, $\frac{3}{4}$ inch	1.20
	SMALL EQUIPMENT (HAND TOOLS)	
6	Scratch awls, 6-inch length	.30
6	Center punch, 4-inch length, 5/16-inch body	.11
2	Hacksaw frames, adjustable, 8-10 to 12 inches	1.75
1	Calipers: micrometer, range 0-1 inch	7.75
1 Pair	Calipers: outside, 8 inches, lock-joint	2.10
1 Pair	Calipers: inside, 6 inch, lock-joint	2.10
3 Pairs	Wing divider, 8-inch length	.83
2	Hammer, ball peen, 8 oz.	.67
1	Hammer, ball peen, 12 oz.	.67
2	Hammer, ball been, 16 oz.	.70
1	Hammer, ball peen, 20 oz.	.75
1	Riveting hammer, 12 oz.	.97
2	Setting hammer, 12 oz.	.97
2	Composition hammer, 9-inch handle, $2\frac{3}{4}$ inches x $\frac{7}{8}$-inch head	1.04
6	Rubber mallet, 14-inch handle, $3\frac{3}{4}$ inches long, $2\frac{1}{4}$ inch dia.	.56
2	Saw files, slim taper, 6 inch	.21
2	Mill files, smooth, 12 inches	.44
1	Mill file, 2nd cut, 12 inches	.40
1	Mill file, bastard, 12 inches	.35
1	Flat file, double cut, 12 inches	.45
1	Flat file, 2nd cut, 12 inches	.25
1	Flat file, smooth, 12 inches	.57
1	Square file, smooth, double cut, 8 inches	.33
1	Three-square file, smooth, double cut, 8 inches	.42
6	File cleaner, steel wire bristles	.50
1 Set	File swiss, composed of the following: round, half-round, flat, oval, knife, 3 square, square, equaling, barret, joining, slitting, marking	3.50
1	Electric soldering iron $\frac{7}{8}$-inch tip	6.65
1	Electric soldering iron 7/16-inch tip	5.50
3	Machinists' vises, 4-inch jaw width, 6-inch opening, stationary	12.75
4 Pairs	Tin snips, 3-inch cut, straight	1.85
2 Pairs	Tin snips, 3-inch cut, curved	2.90
1	Hand groover, 9/32 inch	.95
3	Steel rule, 12 inch, 1/32 inch graduations	.63
1 Pair	Cutting nippers, 8 inches	2.47
3 Pairs	Pliers, flat nosed, 6 inches, steel	.80
2 Pairs	Pliers, round nosed, 5 inches, steel	.92
1	U.S. Standard wire gauge, 0-36	3.00
1	Tap and drill gauge, 2 5/16 inch x $6\frac{1}{4}$ inch	2.40
1	Combination square set: 12-inch blade, square, protractor, center head	6.60
1	Combination square, with level, 12-inch blade	1.00
4	Sheet metal square, body 12 inches x $1\frac{1}{2}$ inches, tongue 8 inches x 1 inch	.80
1	Bar folder	70.00
1	Slip roll former	36.00

Quantity	*Name and Description*	*Approximate Unit Price*
1	Combination machine, rotary, with turning, burring and wiring rolls	$35.00
1	Crimper and beader	16.50
1	Hollow mandrel stake	10.00
1	Blowhorn stake	13.00
1	Hatchet stake	7.00
1	Needle case stake	7.00
1	Bevel edge square stake	9.00
1	Coppersmith's square stake	8.00
1	Beakhorn stake	21.00
1	Conductor stake	4.00
1	Stake bench, maple top, 2¼ inches thick. Stake plate angle irons rabbetted /ush with top and edge. Tubular steel bench legs and steel shelves. Edges turned up. Top 4 feet x 8 feet, 32 inch height	45.00

ELECTRICITY—6 STUDENTS

Large Equipment

1	Table (to be constructed in shop). Overall size of top, 2 feet 6 inches x 8 inches. Overall height 30¾ inches. Constructed of pressed steel legs, top of 40 bd. ft. of 1¾-inch plain sawed white oak with glued joints	16.40
10	Portable panels, 36 inches x 45 inches white pine	.95

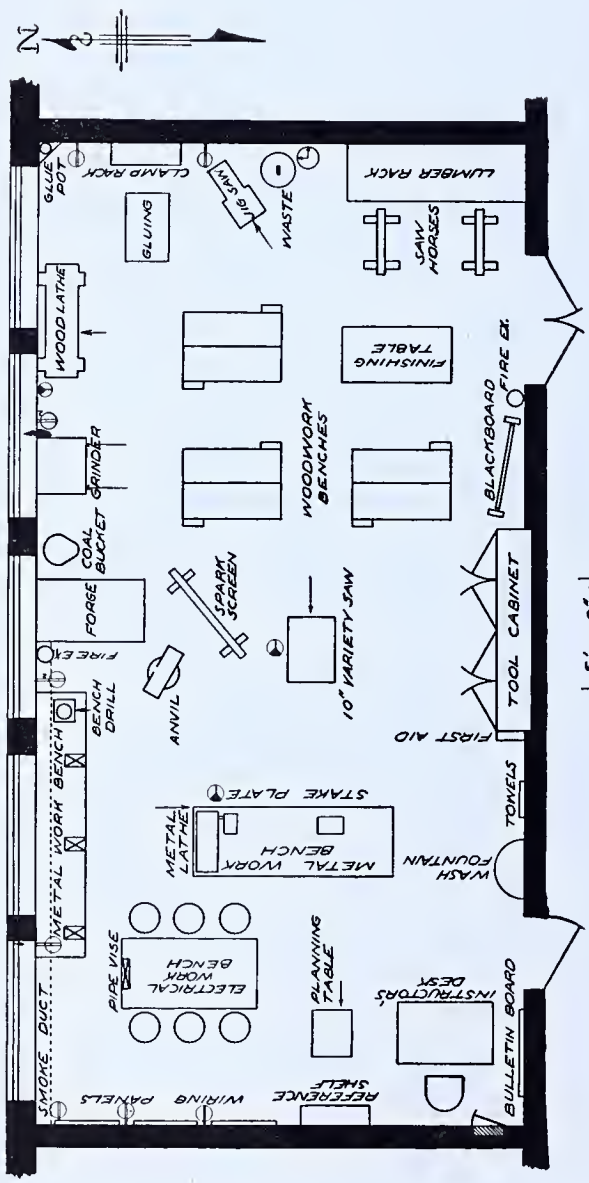
Small Equipment

1	Hammer, 16 oz.	.70
2	Hammer, 10 oz.	.65
6	Screw drivers, thin blade, tapered tips, insulated handles 5 inch length	.45
7 Pairs	Side cutting pliers, 6 inch length	.77
1 Pair	Diagonal cutting pliers, 3 inch length	1.20
12	Sloyd knives, 3½-inch blade	.40
2	Pipe wrench, 8 inch length	.73
1	Pipe vise, ½-inch to 2½-inch capacity	4.35

Small Equipment Miscellaneous

2	Storage batteries, 13 plate, 6 volt, 9 inches x 7 inches x 9⅜ inches	9.20
1	Tungar type rectifier to furnish 7 .5 volts at 2 amperes, designed to operate on 125 volts, 60 cycle alternating current	16.00
1	Syringe type hydrometer to be equipped with float to show numerical value of density as well as condition	1.00
2	Telegraph key with switch	2.00
2	Telegraph sounder, two coil, 5 ohm	3.00
2	Experimental motor, St. Louis type with both permanent and electromagnetic fields	5.00
2	Ammeter, pocket type, DC range 0-40 amperes	.81
2	Voltmeter, Pocket, DC, range 0-40 volts	.81
2	Voltmeter, Pocket, DC, range 0-10 volt	.81
1	Galvanometer, 45 degree angle base	13.00
1	Annunciator, 3 drops	10.50

Quantity	*Name and Description*	*Approximate Unit Price*
10	Entrance cutout box for enclosing fused cutout switch 8 inches x 9 inches x 3 inches black enamel finish	$.75
10	Entrance cutout switches, double pole, main line, 30 ampere, 110 volt, fused	.35
20	Octagon outlet box, knockouts in sides 3¼ inches	.05
20	Outlet box covers, 3¼ inches	.03
15	Snap switches, single pole	.32
10	Snap switches, three-way	.61
15	Toggle switches, single pole	.13
10	Toggle switches, three-way	.24
1 Pack	Keyless receptacles, 3¼ inches porcelain on metal cover	.14
12	Attachment plugs, soft rubber, cap and base	.06
20	Door bells, double coil 2½ inches	.31
20	Buzzers, double coil, iron box	.29
5	Door bell transformers, 110 to 120 volt, 50 to 133 cycles 10 volt secondary	.64
15	Dry cells, 1½ volts, 25 amperes	.29
1 Pack	Plug fuses, 10 amperes, 125 volt. 12 to pack	.40
8 Doz.	Porcelain tubes, 3-inch length	Doz. .09
8 Doz.	Porcelain tubes, 8-inch length	Doz. .18
8 Doz.	Split knobs, porcelain code standard	Doz. .17
8 Doz.	Porcelain cleat, two wire	Doz. .27
1 Box	Conduit and bushing	1.65
1 Box	Conduit backnuts	.85
25	Cleat receptacles, porcelain, two screwholes, 2-inch spacing	.07
30 ft.	BX cable, 14 gauge, 2 conductors	.04
100	BX connectors, ⅜ inch	.05
20	Push buttons, wrought brass 1⅞ inch	.15
10	Light bulbs, 15 watt, 125 volt	.12
4	Experimental wet cell with assorted electrodes	1.25
1 Pack	Cleat receptacle, porcelain, miniature, 2 screw holes.	.75
1 Pack	Cleat receptacles, porcelain, 2 screw holes	.64
50	Porcelain bushings with lock nuts to insulate switch box knockouts	.05
20	Receptacle, duplex bakelite, mounted on 3¼-inch cover	.45
20	Switch, cover plate type, mounted on 3¼-inch metal cover, 10 amp, 125 volt	.45
20	Receptacle, cover plate type, mounted on 3¼-inch cover	.25
5	Flashlight bulbs, 3.5 volt	.05
	MISCELLANEOUS EQUIPMENT	
1	Wastebasket, 14½ inches high, 13-inch top	.75
1	Instructors desk, 50 inches x 32 inches	29.40
1	Art table, adjustable in height	16.20
1	Swivel arm chair	11.40
1	Blackboard, portable type, of hyloplate composition material	22.00
1	Wash fountain, semi-circular, 36-inch diam., liquid soap dispenser	148.50
6	Oil cans, 1/3 pint, spout 3 inches	.14
1	Paper towel fixture	1.00
3	Saw horses, 24 bd. ft. yellow pine	.50



SUGGESTED FLOOR PLAN FOR A JUNIOR-SENIOR HIGH SCHOOL GENERAL INDUSTRIAL ARTS SHOP 22'-0" X 45'-0"

SHOP TO ACCOMMODATE 18 STUDENTS AS FOLLOWS:
ELECTRICITY - 6 METAL - 6 WOOD - 6
EQUIPMENT SPECIFICATIONS FOR THIS SHOP BEGIN ON PAGE

6. General—Junior High School.[6]

The fact should be borne in mind that for some students enrolled in this general shop the values of the experiences gained will be prevocational; for all students, however, the values will be of a general educational nature. This shop is not designed to furnish vocational preparation.

A textile area is provided in this shop in order to afford the student an insight into the basic processes of the ever-important textile industry. Also because it offers one of the finest opportunities for correlation with art in connection with weaving design and the block printing of fabrics.

It is intended that a storage area be provided under the lumber storage racks. Storage facilities could also be constructed underneath many of the work benches throughout this shop. Furthermore, small unfinished individual work could be kept in student lockers throughout the building. The double woodwork benches as specified, are each provided with twelve half-width drawers, which also augment storage space within the shop.

Practicable methods of applying finishes to junior high school projects scarcely justify the partitioning off of a finishing area within the shop.

The metal working area of this general shop is already quite comprehensive. However, if desired, the thin gauge metal work can be expanded to include sheetmetal work at very little additional cost.

If a school district is unable to equip a twenty-two feet by sixty feet general shop as fully as these specifications suggest, the following changes might be made:

1. Substitute conventional sinks for the wash fountain.
2. Construct open tool panels in the shop to be used in lieu of the specified commercially manufactured tool cabinets.
3. Eliminate the metal lathe.

Whatever is done with respect to deleting certain items, or substituting for others, it is felt that the teacher who is responsible for setting up and administering the course of study should be fully consulted beforehand.

[6] Explanatory notes to be used as reference in considering the suggested floor plan and equipment specifications for a junior high school general industrial arts shop, twenty-two feet by sixty feet, to accommodate twenty-eight students.

SUGGESTED EQUIPMENT SPECIFICATIONS FOR A JUNIOR HIGH SCHOOL INDUSTRIAL ARTS GENERAL SHOP, 22 FEET X 60 FEET

Shop to Accommodate 28 Students

WOOD—8 STUDENTS

Quantity	*Name and Description*	*Approximate Unit Price*
	Power Machines and Accessories	
1	Jig saw, 24-inch capacity	$30.00
1	Stand for jig saw	9.00
1 Doz.	Fine jig saw blades	.40
1 Doz.	Med. jig saw blades	.40
6	Saber blades	.75
1	Wood turning lathe, direct motor drive, 4 speed, ½ H.P., 38 inches between centers, complete with five-eighths cup center, 1-inch spur center, 8-inch comb. rear face plate and hand wheel, 6-inch front face plate, 3-inch rosette chuck, 6-inch and 12-inch tool rests, center drift rod, head block, rear tool shelf, blue print holder, face plate wrench, and square hollow chuck	385.00
	Turning tools (handled)	
1	Skew chisel ½ inch	1.00
1	Skew chisel ¾ inch	1.30
1	Gouge chisel ¾ inch	1.15
1	Round point ¼ inch	1.10
1	Spear point ½ inch	11.20
1	Parting tool ½ inch	1.05
	Large Equipment	
4	Woodworking benches, double, 2 large drawers, 12 small drawers, maple construction, 2 continuous screw vises, 2 dogs; size of top 52 inches x 36 inches	80.00
1	Table for mitre saw, top 2 feet x 4 feet 6 inches, 1¾-inch oak, pressed steel legs. To be constructed. 16 bd. ft.	11.50
1	Lumber rack and project storage rack, to be const. 90 bd. ft. yellow pine, 80 bd. ft. 3 ply ¼-inch fir panel—80 sq. ft.	10.00
1	Clamp rack, 12 bd. ft. yellow pine	.80
	Small Equipment—Miscellaneous	
1	Mitre box—capacity at Rt. Ls—7 inches, 45 degree 5 inches including 20-inch x 4-inch saw	22.00
1 Pair	Goggles with shatter-proof lenses	1.40
2	Oil can, 1/3 pt. covered	.35
1	Oilstone, 1-inch x 2-inch x 8-inch box, one side coarse, one fine	1.45
8	Bench hook, 1 inch x 6 inches x 10 inches—8 board feet oak, 32 screws	.32
5	Bench dusters	.25
6	Bar clamps 24 inches, I-B type	2.00
4	Bar clamps 48 inches, I-B type	2.45

Quantity	*Name and Description*	*Approximate Unit Price*
4	Hand screws—wood, length of jaws 8 inches, open to 4½ inches	$1.15
8	Hand screws—wood, length of jaws 12 inches, open to 8½ inches	1.45
2	Marking brushes (camels hair) one each of following: No. 1, No. 2	.20
4	Varnish brushes, one each of the following sizes: ½ inch, ¾ inch, 1 inch, 2 inches	.15
3	Saw horses 24 board feet yellow pine	.50
	SMALL EQUIPMENT (HAND TOOLS)	
8	Jack plane—14 inches long, 2-inch cutter blade	5.75
8	Block plane—6 inches long, 1⅜-inch cutter blade	1.25
8	Try Squares—rosewood handle, 8-inch blade	.80
1	Bevel square—metal handle, 8-inch blade	1.45
1	Framing square—12-inch x 18-inch, polished	1.90
8	Marking gage—beech, grad. by 16ths	.55
2	Brace—ratchet type, 10-inch swing	3.00
8	Sand paper block, hardwood, cork face, brass screw	.50
1	Hand drill—⅜-inch capacity	3.00
1	Burnisher—oval, 7 inches long	.45
1 Set	Chisels, socket pocket, consisting of one each of the following sizes: ⅛ inch, ¼ inch, ½ inch, ¾ inch, 1 inch	7.30
13	Assortment of auger bits, consisting of one of the following sizes—3/16 to 1 inch grad. by 16ths	.50
1	Expansive bit—⅞-inch to 1½-inch capacity	1.15
5	Assortment of twist drills, consisting of one of the following sizes—1/16 inch to ⅜ inch by 16ths	.07
1	Countersink, rose type ¾-inch	.35
1 Pair	Wing dividers—8 inches	.70
1	Doweling jig with bushings, ¼ inch, 5/16 inch, ⅜ inch, 7/16 inch, ½ inch	3.75
1	Dowel sharpener bit	.40
	Files:	
1	Flat, wood 10 inches	.30
1	Mill, bastard cut 10 inches	.25
1	½ round, bastard cut, 12 inches	.95
1	Round, bastard cut, 12 inches	.40
4	File handles for 10-inch to 12-inch files	.08
2	Claw hammer—bell faced, 13 ounces	1.50
2	Claw hammer—bell faced, 7 ounces	1.45
2	Sloyd knives, 3-inch blades	.40
1	Mallet, hickory, 3-inch x 5-inch head	.40
1	Mallet, rubber, 3-inch x 5-inch head	.85
3	Nail sets—one each of the following sizes: 3/64 inch, 3/32 inch, 5/32 inch	.15
1	Putty knife	.25
8	Rules—2-foot steel—grad. by ⅛ inch and 1/16 inch	.80
1	Screwdriver—cabinet makers, 4-inch blade	.25
1	Screwdriver—cabinet makers, 6-inch blade	.30
1	Nest of saws, including compass and keyhole	1.00
2	Coping frame, pin type	.75
2 Doz.	Coping saw blades, pin type	.25
1	Cross-cut saw, 22 inches long—skew back, 9-point	3.00
1	Rip saw, 22 inches long—skew back, 7-point.	3.00

Quantity	*Name and Description*	*Approximate Unit Price*
8	Back saw, 10 inches x 3 inches, 14-point	$1.50
1	Handscraper—2½ inches x 4 inches	.14
1	Handscraper—3 inches x 5 inches	.14
1	Cabinet scraper—length, 11 inches; 2¾-inch blade	1.30
1	Swans neck scraper—3 inches x 5 inches	.30
1	Spoke shave—10 inches, raised handle	.65
1	Scratch awl—5½-inch blade	.15
1	Grinding wheel dresser—steel wheel	.70
2	Screwdriver bit—one each of following: ¼ inch, ⅜ inch	.25
1	File card, steel back, steel wire bristles	.45

ELECTRICITY—6 STUDENTS

Small Equipment

4	Electric door bell. Double coil, iron box, enameled finish, bell to be 2½ inches, nickel plated	.37
4	Electric buzzer. Double coil, iron box, enameled finish	.35
4	Door bell transformer. 110-120 volt, 50-133 cycles, 10 volt secondary	.64
8	Electric pushbutton. Signalling type, wrought brass throughout, dull brass finish, 1⅞-inch diameter	.17
1 Unit	Cleat receptacle. Porcelain, 2 screw holes, 10 to package	.64
1 Unit	Cleat receptacle. Porcelain, miniature, 2 screw holes 10 to package	.75
4	Snap switch, surface type, single pole, nickel plated cover	.29
4	Snap switch, surface type, three-way, nickel plated cover	.50
4	Cut-out switch. 2 wire, 2 pole, 30 ampere, 125 volt, fused top, fitted for plug fuses	.53
4	Cut-out box, for enclosing fused cut-out, 6 inches x 9 inches x 3 inches, black enamel finish, to be equipped with at least two ½-inch knockouts on either end	.75
16	Porcelain bushing to insulate switch-box knockouts, to be complete with copper locknuts	.05
10 Units	Porcelain sub-bases for surface mounting of switches, to hold switch of 2 5/16-inch maximum and 1⅞-inch minimum diameter, to handle switches with a screw spacing of ¾ inch—1⅜ inch, 10 to a package	.85
12	Octagon outlet box, 3¼ inches with 4 knockouts ½-inch diameter, black finish, 1½-inch depth	.09
4	Receptacle, duplex bakelite, mounted on 3¼-inch metal cover, black finish	.14
4	Switch, cover plate type, mounted on 3¼-inch cover, 10 ampere, 125 volt, black finish	.45
4	Receptacle, cover plate type, mounted on 3¼-inch cover, black finish	.25
1 Unit	Porcelain cleat, 2-wire, 100 to package	1.90
25	BX Connector for 2-wire BX cable 14-gauge, to have rust-proof finish	.05
25	Solderless connectors, to hold 4 number 14-gauge wires by means of a set screw, to be equipped with insulating covering and bear underwriters approval	.05

Quantity	*Name and Description*	*Approximate Unit Price*
1 Unit	Key-type socket, brass shell, dull brass finish, cap to have $\frac{1}{8}$-inch pipe thread, 5 to package	$.64
12	Socket cap bushings, $\frac{1}{8}$-inch pipe thread, composition	.01
1 Unit	Attachment plug, soft rubber, 12 to package	.57
1 Unit	Attachment plug base, bakelite, 12 to package	.57
2	Telegraph key with switch, brass, without legs	2.00
2	Telegraph sounder, 2-coil, 5 ohm	3.00
1	Experimental motor, St. Louis type, with both permanent and electromagnetic field	5.00
1	Experimental wet cell with an assortment of electrodes	1.25
1 Unit	Plug fuses, 10 ampere, 125 volt, 12 to package	.40
12	Bulbs, 10 watt, clear glass, 115 volt	.15
12	Flashlight bulbs, 3.5 volt	.05
1	Ammeter, pocket type, 0-40 amperes D. C.	.85
1	Voltmeter, pocket type, 0-40 volts D. C.	.85
1	Voltmeter, pocket type, 0-10 volts D. C.	.85
1	Tungar type battery charger to furnish 7.5 volts at 2 amperes designed to operate on 105—125 volts 60 cycle alternating current	16.00
1	Storage battery, portable, 6 volt 100 ampere hour capacity, to have extra heavy diamond grid plates and quarter sawed Douglas Fir separators, to be mounted in hard rubber case and have bale handle for carrying	15.40
1	Syringe type hydrometer to be equipped with float to show numerical values of density as well as condition of charge	1.00
	LARGE EQUIPMENT	
1	Bench for electricians, overall size of top 2 feet 6 inches x 8 feet, overall height $30\frac{3}{4}$ inches, to be constructed with pressed steel legs, top to be of $1\frac{3}{4}$-inch plain sawed white oak, with glued joints. Top is to be sanded and given 3 coats of a good waterproof shellac or lacquer	16.40
	Materials for construction of this bench are as follows:	
2	Pressed steel bench legs, 20 inches high, $28\frac{1}{2}$ inches across the top	3.00
40 Bd. Ft.	Plain sawed white oak 2 inches thick, S2S to $1\frac{3}{4}$ inches	.21
1 Unit	Finishing materials and hardware to fasten top to legs	2.00
6	Steel frame tools, with wooden seat $14\frac{1}{2}$-inch diameter, total height of stool to be 20 inches	3.30
1	Wiring booth assembly to be constructed in "U" shape, back of booths to be open, inside to be sheathed with white pine, base of "U" shape to be 5 feet wide, wings to be 4 feet wide, total height of booth to be 6 feet, sheathing to cover the top 3 feet of the base and wings. Frame to be constructed of 2-inch x 4-inch fir	7.61
	Materials for construction of this bench are as follows:	
54 Bd. Ft.	2 inches x 4 inches fir, S4S	.06
43 Bd. Ft.	White pine sheathing, 1 inch x 12 inches, S2S No. 2 common	.09
1 Unit	Hardware for construction	.50

Quantity	*Name and Description*	*Approximate Unit Price*
	Hand Tools	
8	Electricians' side-cutting pliers, 6 inches	$.90
8	Electricians' screwdriver, 6-inch blade, transparent plastic handle	.85
8	Sloyd knife, 1⅝-inch blade	.35
4	Claw hammer, ripping pattern, 13-ounce head	1.00
2	Electric soldering iron, ⅞-inch tip, 110 volt	6.75
1	Hacksaw frame, capacity 8-inch to 12-inch blades, pistol grip	1.50
	METAL—8 STUDENTS	
	Power Machines and Accessories	
1	Portable electric drill with ½-inch chuck	53.00
1	Bench drill stand	22.00
1 Set	Straight shank twist drills, sizes 1/16 inch to ½ inch by 1/64 inch. Set complete with metal stand	19.00
1	Tool grinders, direct motor drive, 1/3 H. P., 1800 R.P.M. 1 8-inch dia. 2-inch face, coarse oilstone 1 8-inch dia. 2-inch face, fine oilstone 1 8-inch dia. grinding cone, 5 inches long 1 8-inch dia. ½-inch face grinding wheel Tool holder	175.00
1 Pair	Goggles with shatter proof lens	1.40
1	Lathe, metal minimum—9-inch swing, bed 3 feet long, distance between centers 16⅜ inches, ½ H. P. motor, std. change gears instant reversing motor	425.00
1	Chuck, lathe, 4-jaw independent, 6-inch capacity	23.00
1 Set	Lathe dogs, one each of following: ½ inch, ¾ inch, 1 inch, 1¼ inch	4.25
1	Knurling tool and holder	3.00
1 Set	Cutter bits, unground, ¼-inch square, 2 inches long, 6 in a set	.90
1	Tool holder, straight, for ¼-inch cutter	1.25
	Large Equipment.	
1	Anvil, 200 pounds	60.00
1	Forge, 10 gage steel plate, hearth 30 inches x 36 inches x 6 inches, electric blower	55.00
1	Spark screen 6 feet high, 8 feet long, to be constructed	10.00
	Forge tools:	
1	Flatter, weight 2 pounds, 2 inches square	1.90
1 Set	Fuller, top and bottom, ½ inch, 2¾ lbs.	3.25
1	Round punch ½ inch	1.35
1	Fire shovel	.50
1	Hot cutter 1¾-inch cutting edge	1.65
	Hammers (handled)	
1	3 lbs.	1.10
1	5 lbs.	1.45
1	Regular hardies	1.20
1	Cold cutter 1¾-inch cutting edge	3.10
1	Swage, top ½ inch	1.70

Quantity	*Name and Description*	*Approximate Unit Price*
1	Swage, bottom ½ inch	$1.70
	Tongs:	
1 Pair	Straight lip, 18 inches long	1.40
1 Pair	Single pick-up, 18 inches long	1.95
1 Pair	Straight lip to hold squares, 20 inches long	1.50
1	Bench for metal workers, top 2 feet x 20 feet, 27 inches high with 3 pressed steel legs, top 1¾-inch oak	35.00
1	Coal bin 4 feet square, 3 feet high, yellow pine, 48 board feet	7.00
1	Bench for layout work in metal shop: Top 4 feet x 6 feet, 27 inches high, pressed steel legs, top 1¾-inch plain white oak	24.00

Small Equipment (Hand Tools)

3	Brushes, 8 inches	.40
3 Pairs	Pliers, flat square nose	.90
2	Tinners awl	.55
2 Pairs	Snips, 3-inch blade	2.50
2	Soldering iron, 1 lb.	.45
	Files:	
3	10-inch flat bastard cut	.50
2	10-inch mill smooth cut files	.40
2	10-inch half round	.60
2	10-inch round bastard	.40
10	Wood file handles for 8- to 10-inch files	.15
	Gages:	
1	Center, U. S. std.	.50
1	Depth, 6-inch blade	1.50
1	Screw pitch gage, V shape	1.25
1	Drill 1-60 sizes	2.00
1	Wire, American std. 0-36	3.00
1	Surface, 9-inch spindle	3.50
1 Set	Tap and die, screw plate. U. S. std. ¼ inch, 5/16 inch, ⅜ inch, 7/16 inch, ½ inch	9.00
2	Screwdrivers, 6-inch blade, 5/16-inch	.65
2	Screwdrivers, 8-inch blade, ⅜ inch	.80
2	Scales, steel. 6-inch, 4 graduations	.90
2	Mallets, hickory	.40
1	Hack saw frame, capacity 8-inch—12-inch blades, pistol grip	1.50
1 Set	Center punches, 1/16 inch, 3/32 inch, ⅛ inch, 5/32 inch, 7/32 inch	1.50
4	Vises, machinist, stationary base, width of jaws 3½ inches, open to 5 inches	11.25
	Hammers:	
1	Riveting, 8 ounce, 4 inches long, ⅝-inch face	.90
1	Raising	2.10
2	Planishing	2.10
	Ball peen:	
2	8 ounces	.70
2	1 pound	.70
2	2 pounds	1.00
1	Square, body 12 inches x 1½ inches, tongue 8 inches x 1 inch	1.00

Quantity	*Name and Description*	*Approximate Unit Price*
	Calipers:	
1 Pair	Pocket slide, 3 inches, inside and out	$4.00
1 Pair	Micrometer 0-inch-1-inch with ratchet	6.75
1	Micrometer caliper case	1.25
	Cold chisels:	
2	½ inch, 6 inches long	.35
2	¾ inch, 7 inches long	.50
2	1 inch, 8 inches long	.85
2	Machinists' clamp, jaws opening to 3½ inches	2.30
1	Combination square 9 inches, square and center heads hardened	8.25
2 Pairs	Dividers, spring, adjustable screw	1.20

TEXTILES—6 STUDENTS

Large Equipment

2	Textile tables, 5 feet 0 inches x 2 feet 6 inches x 2 feet 6 inches, top of selected birch, 2 drawers	30.00
8	Stools for above table, 18 inches high, 14-inch diameter scooped and rounded birch seat, riveted steel construction	2.45
1	Floor loom, four harness, four treadle loom which will weave up to 42 inches wide. Maple construction, complete with a sectional warp beam, one spool rack with wires to hold 45 spools; 700 steel wire heddles; 5 No. 1 shuttles; one crank; one temple; stretcher; one reed and heddle hook; 15 sectional clamps; one sectional reed; one malleable wrench	50.00
2	Table looms, 4 harness loom, 14-inch capacity. Complete with a reed, 2 shuttles, 2 lease sticks, 2 reed hooks, and an extra warp beam	22.00

Small Equipment

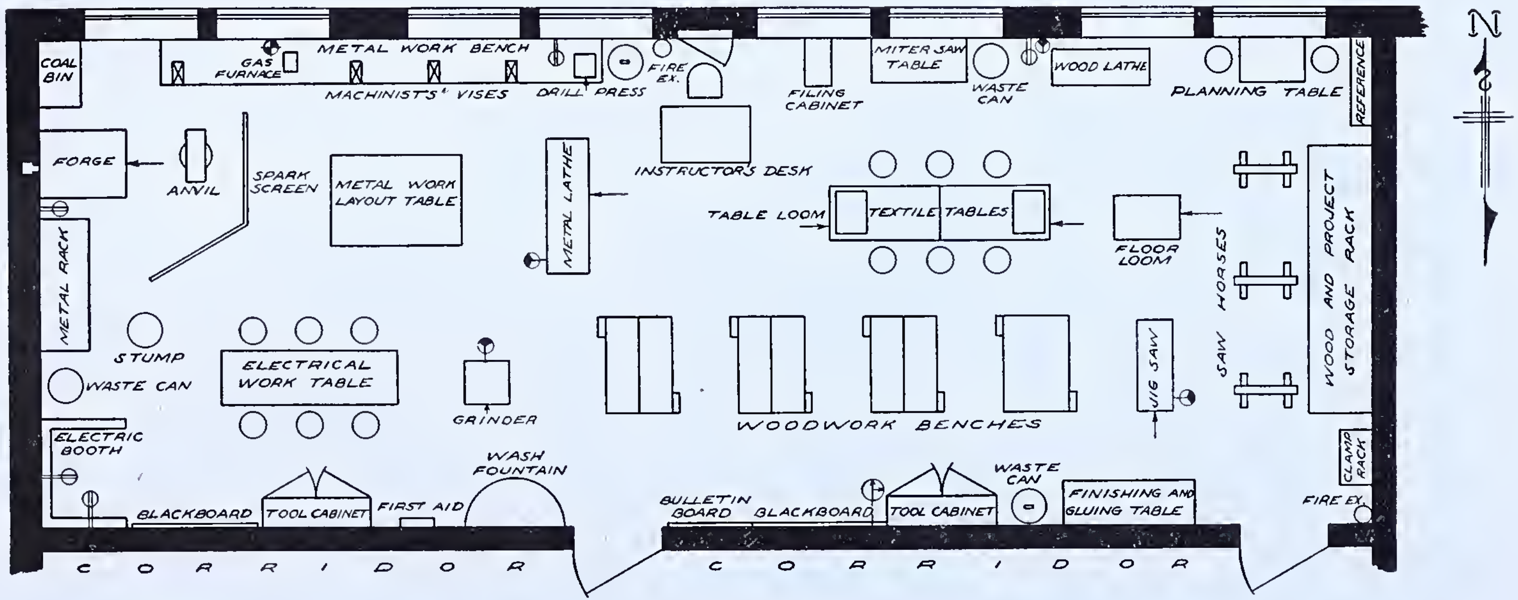
8	Table weave it frames, senior size	1.00
4 Doz.	Wooden loom needles for above frames	.50
	Circular rake knitting frames:	
1	5⅝-inch dia.	.60
1	8-inch dia.	.75
1	11-inch dia.	1.00
1	13½-inch dia.	1.25
1	15-inch dia.	1.50
2	Straight rake knitting frames, 15¼ inches long	.75
1	Bobbin winder	4.50
1	Spool rack 7 inches long	4.50
1	Warp frame for 10 yard warp chain	5.00
1	Swift, type A	5.00
4	Bobbin shuttles 12 inches long	1.50

AUXILIARY EQUIPMENT

Large Equipment

1	Three-section bookcase, 12 inches x 34 inches x 38 inches. Glazed doors slide into case when open	25.00
1	Steel filing cabinet, fire resisting, 4 drawers	28.00
4	Garbage cans, metal, 25 gallons, tight cover	2.00

Quantity	*Name and Description*	*Approximate Unit Price*
1	Waste basket, metal	$1.00
1	Fire Extinguisher, 2½ gallons, soda and acid type	11.00
1	Instructors desk, 30 inches wide, 54 inches long, 30 inches high, oak, six drawers	25.75
8	Stools, steel, 18 inches high; 14-inch birch seat	2.45
1	Instructors chair, quarter sawed oak, 18 inches high	7.75
1	Planning table, 24 inches wide, 36 inches long, 30 inches high, quarter sawed oak, one long drawer	11.90
2	Chairs for planning table, 18 inches high, plain sawed white oak	2.95
2	Tool cases, 5 feet 6 inches long, 16 inches deep, 6 feet high, white oak, complete with shelves, drawers, and other methods of storing tools	196.00
1	Bulletin board, 24 inches x 36 inches, cork in hard wood frame	6.00
1	Wash fountain, 54 inches, semi circular, enameled iron, hand controlled. Capacity—6 persons	166.50
	SMALL EQUIPMENT	
1	First aid cabinet, 10 inches x 12 inches x 3½ inches, steel construction	3.95
1	Liquid soap dispenser, plunger, glass bowl type	2.40
1	Towel cabinet, steel	1.00
1	Pencil sharpener, takes all sizes of pencils	1.25
2	Blackboard rules, 36 inches long	.75
3	Blackboard erasers	.15



SUGGESTED FLOOR PLAN FOR A JUNIOR HIGH SCHOOL GENERAL INDUSTRIAL ARTS SHOP

22'—0" X 60'—0"

SHOP TO ACCOMMODATE 28 STUDENTS AS FOLLOWS:

TEXTILES—6 ELECTRICITY—6 METAL WORK—8 WOODWORK—8

SUGGESTED EQUIPMENT SPECIFICATIONS FOR THIS SHOP BEGIN ON PAGE

7. General—Senior High School.[7]

The fact should be borne in mind that for some students enrolled in this general shop the values of the experiences gained will be prevocational; for all students, however, the values will be of a general educational nature. This shop is not designed to furnish vocational preparation.

Difficulty may be encountered in visualizing the physical possibility of a thirty feet by sixty feet shop in a school building of standard construction. One plan, and the best, would be to add it as a wing of a building. Another would be to throw two standard classrooms on the same side of a corridor and the corridor into one large area. It is true, however, that this would inconvenience entrance and egress with respect to the classrooms remaining on the other side of the corridor. Still another possibility would be to reduce the size of the shop to thirty feet by fifty-four feet; to be obtained by combining two standard classrooms on opposite sides and at the end of a corridor, with the corridor. It is admitted that a "run of the mine" industrial arts teacher would experience considerable difficulty in teaching in a shop with activities as varied as in this one. Nevertheless, there are many teachers capable of handling it, and the student enrichment to be gained through such comprehensive exploration is limitless.

Tool panels have been spotted around this shop so that the tools required for each area will be readily accessible. Storage space will likewise be distributed. A number of the specified bench units have built-in storage space. With a little effort, additional storage space can be constructed under other work benches. For instance, all the printing paper required could be stored under the proof press table.

In the event that a rearrangement of equipment is desired, care should be taken to keep the working areas that demand reasonable cleanliness as remote as possible from the forge and other dirty areas. Another solution, of course, would be to construct paneled clear glass partitions around areas to be kept clean.

A downdraft forge has been specified. Smoke from such a forge can be led through a duct under the floor to a chimney in a more remote part of the building. A hood has not been shown over the melter for the sake of clarity, although such a hood is desirable provided an exhaust to the outdoors is available. No vent is required on the ceramics kiln as it is fired electrically.

Whatever is done with respect to deleting certain activities or certain items or substituting for others, it is felt that the teacher who is responsible for setting up and administering the course of study should be fully consulted beforehand.

[7] Explanatory notes to be used as reference in considering the suggested floor plan and equipment specifications for a senior high shool general industrial arts shop, thirty feet by sixty feet, to accommodate thirty students.

SUGGESTED EQUIPMENT SPECIFICATIONS FOR A SENIOR HIGH SCHOOL INDUSTRIAL ARTS GENERAL SHOP, 30 FEET X 60 FEET

Shop to Accommodate 30 Students

WOOD SHOP—8 STUDENTS

Power Machinery and Accessories

1	Lathe, direct motor drive, 60-inch bed, 36 inches between centers	$350.00
1	Turning gouge, outside ground, $\frac{5}{8}$ inch	.98
1	Turning gouge, outside ground $1\frac{1}{4}$ inch	.96
1	Parting tool, $\frac{5}{8}$ inch	1.05
1	Round turning chisel, $\frac{1}{4}$ inch	.80
1	Square chisel, 1 inch	1.30
1	Right skew chisel, $\frac{1}{2}$ inch	.90
1	Left skew chisel, $\frac{1}{2}$ inch	.90
1	Diamond turning chisel, $\frac{1}{2}$ inch	.90
1	Variety saw, direct motor drive, table 33 inches x 34 inches, 10-inch saw, tilting arbor; including one 10-inch rip saw, one 10-inch cross-cut saw, and one 6-inch dado head complete	158.75
1	Band saw, motor driven, 20-inch wheel	295.00
1	Hand jointer, 8-inch blade, direct motor drive	350.00
1	Variety oilstone grinder, 2 oilstone wheels 8 inches, one emery wheel 8 inches—$\frac{1}{2}$ inch, speed 1800 R. P. M.	195.00

Large Equipment

1	Wash fountain, 54-inch half circle, capacity 6	155.00
1	Swivel chair	11.45
2	Stools, 14-inch disk top, steel legs 18 inches	4.25
1	Reference shelf, 3 feet x 4 feet x 9 inches (cost of materials)	3.00
2	Waste cans, covered, 2 feet x 4 feet	6.00
1	Waste can, $2\frac{1}{2}$ feet x 4 feet	6.95
1	First aid cabinet	24.00
1	Towel case (for paper towels)	1.00
1	Steel filing cabinet, four legal sized drawers, outside dimensions $17\frac{7}{8}$ inches x $26\frac{1}{2}$ inches x $51\frac{7}{8}$ inches	33.00
1	Instructors desk, mahogany finish, complete with three drawers approximately 32 inches long, bottom	
1	drawer can be used for legal sized filing folders..	32.00
1	Finishing table, 6 feet x 3 feet x 34 inches, bottom of table is divided into two cabinets for the storage of finishing equipment, storage compartments are supplied with lock and key, top is made of $2\frac{1}{2}$-inch maple wood	95.00
4	Double woodworkers' bench, 52 inches x 36 inches x 30 inches, complete with eight drawers in each bench, continuous screw vise, top of $2\frac{1}{2}$-inch maple	98.00
1	Portable blackboard, 3 feet 6 inches x 4 feet 6 inches	20.00

Small Equipment

8	Jack planes, corrugated bottom, 11½ inches long	$4.50
8	Block planes	2.95
8	Marking gauges	1.00
2	Butt gauges	1.80
5	Back saws	2.00
1	Clamp rack (cost of material)	5.00
1	Rip saw, 7 points per inch	2.33
1	Rip saw, 6 points per inch	2.56
1	Cross-cut saw, 10 points per inch	2.57
1	Cross-cut saw, 8 points per inch	2.57
4	Coping saw frames, 6 inches	.63
4	Claw hammers, 13 ounces	1.45
2	Claw hammers, 10 ounces	1.15
8	Try squares, 6-inch blade, 4⅜-inch handle	.80
2	Bevel squares, 6-inch blade, 4½-inch handle	.65
1	Framing square, 2-foot body, polished finish	.55
5	I-Bar clamps, 3 feet	2.16
4	I-Bar clamps, 4 feet	2.43
2	I-Bar clamps, 5 feet	2.70
2	I-Bar clamps, 6 feet	2.97
6	Adjustable hand screws, 7-inch jaws, 3½-inch opening	1.02
6	Adjustable hand screws, 10-inch jaws, 6-inch opening	1.28
4	Adjustable hand screws, 14-inch jaws, 10-inch opening	1.60
2	Ratchet braces, 8-inch sweep	5.25
1	Glue heater, removable copper inset with bale, asbestos heat insulated, thermostatic heat control	18.50
3	Glue brushes, ½-inch diameter, bridled	.15
3	Glue brushes, 1-inch diameter, bridled	.40
1	Miter box and saw, saw 28 inches x 5 inches	30.00
1	Nest saws (three blades), pruning, compass, keyhole	1.49
1	Set 13 auger bits, sizes 4 to 16, double leadscrews	6.50
1	Expansive bit, 2 cutters from ⅞ inch to 3 inches	1.28
2	Rosette countersinks, wood or soft metal, ¾ inch	.35
1	Dowling jig with 5 guides, ¼ inch, 5/16 inch, ⅜ inch, 7/16 inch, ½ inch	2.50
1	Hand drill, capacity ¼ inch, 3½-inch speedgear	2.55
1 Set	Butt chisels, ⅛ inch to 1½ inches	14.50
1	Spiral ratchet screw driver	2.68
4	Screw drivers, 4-inch blades	.35
2	Screw drivers, 6-inch blades	.42
2	Screw driver bits, ¼-inch blades	.23
12	Nail sets, length 4-inch, sizes 1/16, 3/32, ⅛, 5/32	1.50
6	Hand scrapers, 3 inches x 4 inches	.13
2	Cabinet scrapers, length 11 inches, cutter 2¾ inches, malleable iron	1.70
1	Spoke shave, length 10 inches, cutter 2⅛ inches, malleable iron	1.10
1	Combination square with level, 12-inch steel blade adjustable	1.25
1 Pair	Goggles, replaceable shatterproof lens	1.42
1	Combination coarse and fine oilstone, 2 inches x 6 inches	1.04
2	Combination slip joint wire cutters	.33
1 Set	Twist drills, 1/16, ½ by 64th, cartbon steel	6.25
12	Half round cabinet wood file, length 10-inch	.69
6	Half round cabinet wood rasp, inch 2nd. cut, smooth, three of each, 10-inch length	.59

Quantity	*Name and Description*	*Approximate Unit Price*
12	Bench dusters	$.23
1	Slip stone, 4½ inches	.54
1	Automatic push drill	2.35
1	Scraper burnisher	.48
1	Grinding wheel dresser, steel wheel type	.68
4	C. clamps, 8 inches	1.05
12	Sloyd knives, 2½ inches	.38
5	Tempered steel rules for bench use, 24 inches long, 1¼ inches wide	3.25

METAL SHOP—8 STUDENTS

Power Machinery and Accessories

1	Down draft forge, hearth 30 inches x 30 inches x 6 inches, complete with blower, half hood 12 inches, motor switch and speed regulator	135.00
1	Floor type gas furnace for melting aluminum, brass, copper, etc., complete with floor legs, gas burners and crucible with a capacity of 40 cubic inches	40.00
1	Drill complete with motor, pulley, switch, floor pedestal and 0-inch to ½-inch capacity chuck	120.00
1	9-inch underneath belt motor driven precision bench lathe including face plate and wrenches, ½ H. P.	390.00
	Accessories for the above:	
1	Lathe dog, ½ inch	.60
1	Lathe dog, 1 inch	.80
1	Lathe dog, 2 inches	1.35
3	60 degree head spindle centers	2.00
3	60 degree tail spindle centers	2.25
1	Hollow arbor chuck 3/16 inch to ¾ inch	14.25
1	Knurling tool 5/16 inch to ¾ inch	.80
1	Cut off tool, 3/32 inch to ½ inch	2.55
1	Straight lathe tool holder ¼ inch x ¼ inch	1.25
1	Right lathe tool holder ¼ inch x ¼ inch	1.25
1	Left lathe tool holder ¼ inch x ¼ inch	1.25

Large Equipment

2	Metal stock racks, upright posts, double posts, 2 pedestals	50.15
1	Cabinet bench (steel), 42 inches x 9 inches, 3 shelves, 2 sliding doors	80.00
1	Metal workers table, 8½ inches x 40 inches, (wood), including 2 stake holders, 4 shelves	45.00
1	Blacksmiths and forge shop rack 20 inches x 26 inches	67.15
1	Molding bench, to be constructed 2½ inches x 3 inches, 35 board feet lumber	5.00
1	Coal box, to be constructed, 31 board feet lumber	2.75
1	Spark screen including mesh, to be constructed 4 feet x 5 inches x 5 inches	10.00

Small Equipment

1	Anvil 100 lbs.	16.50
4	Double burner bench soldering furnaces 3¾ inches x 4½ inches x 5½ inches	14.50
1	Slip roll former, 30 inches x 2 inches	29.00
1	Hatchet stake, 11 inches	6.00
1	Candle mold stake	7.00
1	Hollow mandrel stake, 9 inches x 40 inches	9.00

Quantity	*Name and Description*	*Approximate Unit Price*
1	Needle case stake	$6.50
1	Beak horn stake, 19 inches	20.00
1	Blow horn stake, 27 inches	11.50
1	Coppersmith square stake	7.50
1	Double seaming stake 29 inches	19.50
1	Bevel edge square stake	8.00
5	Bench machinists vises, stationary 4 inches	12.75
1	Art metal anvil and stake, 10½ inches x 1⅜ inches	.4.00
1	Revolving hand machine standard, 30 inches x 39 inches, 10 machine holders	50.00
1	Beading machine, ¼ inch and ¾ inch	29.00
1	Setting down machine	28.00
1	Crimping machine	16.50
1	Combination rotary sheetmetal machine	29.95

HAND TOOLS

1 Pair	Blacksmith tongs, straight lip, ¼ inch wide, 20 inches long	1.07
1 Pair	Blacksmith tongs, curved lip, ½ inch wide, 20 inches long	1.23
1	Bottom fuller, ½-inch wide	1.25
1	Top fuller, ½-inch wide	1.25
1	Anvil hardie, 1-inch shank	.91
1	Hot cutter, 1½-inch shank	1.38
1	Square flatter, 2 inches	1.38
1	Blacksmith sledge hammer, 8 lbs., handled	1.60
1	Blacksmith hand hammer, 3 lbs, handled	.84
1	Ball peen hammer, handled, 28 ounces	.86
1	Round punch, ½ inch	.96
2	Jeweler's saw frames, 5 inches	1.10
2	Planishing hammers, 5¾ inches	1.80
1	Chasing hammer, 1¼ inches	1.60
1	Forming hammer, 5¼ inches	1.80
3	Ball peen hammers, 12 ounces	.67
2	Ball peen hammers, 16 ounces	.70
2	Ball peen hammers, 24 ounces	.80
2	Soft rubber mallets, 18 ounces	.56
2	Hard rubber mallets, 18 ounces	1.85
2	Tinner's Riveting hammer, 16 ounces	1.02
1	Tinner's raising hammer, 28 ounces	1.63
2	Tinner's Riveting hammer, 16 ounces	1.02
1	Tinner's Setting hammer, 16 ounces	1.02
1	Set Swiss needle files (12), 4¾ inches long	2.80
1	Steel protractors	1.75
1	Tap and drill gage, 2 5/16 x 6¼ inches	2.40
1	Center Gage	.50
1	United States Standard gage, 0 to 36	3.00
1	American standard wire gage, number 5 to 36	2.50
1	Thickness gage	1.50
3	Screwdrivers, 6-inch blade	.46
3	Screwdrivers, 3-inch blade	.36
3	Screwdrivers, 12-inch blade	.88
1	Adjustable angle wrench, 8 inches	.62
1	Adjustable S wrench, 8 inches	.95
1	Tappet wrench set, ½ inch, 9/16 inch, ⅝ inch, 11/16 inch, ¾ inch, ⅞ inch	4.00
1	Monkey wrench, 10 inches	1.13

Quantity	*Name and Description*	*Approximate Unit Price*
10	Steel rules, 12 inch, 1/16 inch graduations	$.90
1	Combination Set, center head, square and protractor, 12 inches	7.50
1	Micrometer caliper, 0 inch to 1 inch	6.50
1	Micrometer caliper, 1 inch to 2 inches	7.00
1	Universal surface gage, 9 inches	3.50
1	Depth gage, 6 inches	1.50
2 Pairs	Soldering coppers with handles, 1 lb.	.30
1 Pair	Soldering coppers with handles, 2 lbs.	.40
1 Pair	Soldering coppers with handles, 3 lbs.	.50
4 Pairs	Tin snips, straight lip, 3 inches	1.68
1 Pair	Tin snips, curved lip, 3 inches	2.75
4	Sheet metal squares, 12 inches by 8 inches	.75
5 Pairs	Flat nose pliers, 6 inches	.63
1 Pair	Needle nose pliers, 6 inches	.91
2 Pairs	Round nose pliers, 5 inches	.50
1 Pair	Cutting nippers, 8 inches	2.34
6	Scratch awls, ring type	1.86
2	Cold chisels, $\frac{1}{4}$ inch	.13
2	Cold chisels, $\frac{3}{8}$ inch	.13
2	Cold chisels, $\frac{1}{2}$ inch	.17
2	Cold chisels, $\frac{3}{4}$ inch	.31
1	Cape chisel, $\frac{1}{4}$ inch	.24
1	Cape chisel, $\frac{3}{8}$ inch	.40
2	Hack saw frames, 8 inches to 12 inches	1.84
1	Set twist drills, 1/16 inch to $\frac{1}{2}$ inch by 64ths, carbon steel	8.13
1	Center punch, 5/16 inch, 4 inches	.14
1	Center punch, $\frac{3}{8}$ inch, 4 inches	.14
1	Center punch, $\frac{1}{2}$ inch, 4 inches	.14
2 Pairs	Lock joint outside calipers, 8 inches	2.10
2 Pairs	Lock joint inside calipers, 8 inches	2.10
1	Lifter, $\frac{3}{8}$ inch x 12 inches	.95
1	Heart and oval spoon, 1 inch x $1\frac{1}{4}$ inches	1.00
1	Heart and square slick, $\frac{3}{4}$ inch	.75
1	Stone slick, $\frac{5}{8}$ inch	.70
6	Half round bastard files, 12 inches	.50
6	Half round smooth files, 12 inches	.58
6	Half round 2nd cut files, 12 inches	.57
3	Round smooth files, 12 inches	.42
6	Round 2nd cut files, 12 inches	.37
6	Bastard mill files, 12 inches	.33
6	2nd cut mill files, 12 inches	.40
6	Smooth mill files, 12 inches	.40
6	Flat bastard files, 12 inches	.44
6	Flat 2nd cut files, 12 inches	.50
6	Flat smooth files, 12 inches	.54
6	Square 2nd cut files, 12 inches	.52
6	Triangle single cut files, 12 inches	.56
6	Triangle double cut files, 8 inches	.65
2 Dozen	File cards, $8\frac{1}{2}$ inches	.10
6	Prick punches, $\frac{3}{8}$ inches to $4\frac{3}{4}$ inches	.18
1	Rivet set, 2 lbs.	.40
1	Rivet set, 1 lb.	.33
1	Hand Groover, 5/16 inch	.97
1	Hand Groover, $\frac{1}{8}$ inch	.90
4 Pairs	Dividers, 6 inches	.55

Quantity	*Name and Description*	*Approximate Unit Price*
2 Pairs	Dividers, 10 inches	$.93
2 Pairs	Tool makers parallel clamps, 3½ inches	2.30
1 Pair	Firm joint hermaphrodite calipers, 6 inches	1.00
1	Slick and bead, ¾ inch	.80
2	Moulders' riddles, 16-inch diameter	.63
1	Sprue cutter, ½ inch x 10 inches	.30
1	Sprue cutter, ¾ inch x 10 inches	.50
	MISCELLANEOUS	
1 Doz.	Oil cans, 3⅜ inches diameter	.36
2	Bulb sponges, 10 inches to 12 inches	1.25
1	Moulders bellows, 8 ounces	2.10
3 Pair	Safety goggles, shatter proof, lens replacable	1.42

PRINT SHOP—5 STUDENTS

POWER MACHINES AND ACCESSORIES

1	Platen press 10 x 15, single disk, gear and pinion guard crank shaft, 2 chases, 6 rollers, 2 wrenches	435.00
	Extras for press:	
3	Cast rollers	4.35
1	Fibre fly wheel guard	3.50
1	Motor bracket with belt tighting	25.00
1	Platen guard	10.00
1	Endless leather belt	5.00
1	¼ H. P. variable speed motor	77.00
1	Brake	11.00
1	Belt guard	10.00

LARGE EQUIPMENT

1	19-inch paper cutter with approved safety device	150.00
1	Steel table, 36 x 80 x 32 inches. Inks, rolls, stock, oil can and benzine can to be stored in space built below top	60.00
1	Proof press with steel cabinet, ink plate and brayer	75.00
1	Imposing stone 27 x 39 x 38 inches. All steel, with reglet and wood furniture units. Contains letter-board unit and drawer	185.00
1	Composing stands with double tier top, sloping both ways, overhead lead and slug capacity for 17 cases	131.00

SMALL EQUIPMENT

1	Font reglet	18.00
1	Font of wood furniture	27.50
2	Fonts of 2 point leads 5 to 10 picas	10.00
2	Fonts of 6 point slugs 5 to 10 picas	9.00
1	Rule and slug cutter	2.50
15 Lbs.	Metal furniture	5.25
2 Lbs.	10 point brass rule	5.00
1	Font of 2 point brass mitres for rule	1.10
1 Lb.	12 point braces and dashes	1.25
2 Lbs.	Line leaders, 4 dots to an em	2.50
½ Lb.	10 point references	.75
4	Stainless steel composing sticks, 2 inches x 6 inches	15.60

Quantity	*Name and Description*	*Approximate Unit Price*
2	Stainless steel composing sticks, 2 inches x 10 inches	$11.40
28	California Job cases	48.00
1	Type planer, 3½ inches x 8 inches	.65
1	Felt base proof planer, 3½ inches x 8 inches	1.25
1	Wooden mallet	1.00
1 Doz.	Quoins, size 1	1.65
1	Quoin key	.65
1 Doz.	Gauge pins	2.00
	Benzine can, 1-quart capacity	1.75
11	Pressed steel galleys	4.51
1	Ink spatula	.75
1	5 wheel numbering machine	9.00
1	Set of linoleum carving tools:	
	2 Handles and 6 cutters	.75
1	Hand stapler	5.00
	Type	
Fonts:		
1	6 point Goudy Oldstyle 29A	2.75
1	8 point Goudy Oldstyle 27A	3.35
20 Lbs.	10 point Goudy Oldstyle 24A, per font	8.50
2	12 point Goudy Oldstyle 21A, per font	9.30
2	14 point Goudy Oldstyle 17A, per font	10.10
2	18 point Goudy Oldstyle 12A, per font	10.90
2	24 point Goudy Oldstyle 8A, per font	11.70
1	36 point Goudy Oldstyle 6A	8.30
1	10 point Goudy Italic 26A	4.15
1	14 point Goudy Italic 19A	5.05
1	18 point Goudy Italic 14A	5.45
1	14 Trafton Script	6.35
1	18 point Trafton Script	6.50
1	24 point Trafton Script	6.70
1	36 point Trafton Script	7.45
1	10 point Futura	3.30
2	12 point Futura	7.20
1	14 point Futura	4.10
1	18 point Futura	5.15
1	12 point Shaw Text	4.35
1	18 point Shaw Text	5.50
	Miscellaneous	
1	Bone folder, 1 inch x 8 inches	.30
1	Printer's finger	.25
1	Waste can, 18 inches diameter, 24 inches high	1.75

CERAMICS—2 STUDENTS

Power Machines and Accessories

1	Electrical potters' wheel	98.00

Large Equipment

1	Kiln, 8 x 12 x 12 inches inside dimensions (Electrical)	198.00
1	Damp cabinet, 36 x 18 x 22 inches	4.00

Quantity	*Name and Description*	*Approximate Unit Price*
	Small Equipment	
2	Sets of molding tools	$3.00
1 Gross	Stilts	.70
1 Gross	Saddles	.50
	Miscellaneous	
2	Sponges, large	2.00
2	Sponges, small	2.00
2	Round bottom basins	1.50
2	Finishing rubbers, 2 x 3½ inches	1.00

WEAVING—2 STUDENTS

	Large Equipment	
1	Table loom, large	30.00
1	Table loom, small	10.00
1	Tapestry loom, table size	15.00
	Miscellaneous	
1	Shuttle winder	1.50
1	Shuttles	5.00
6	Draw in hook	.35

ELECTRICITY—5 STUDENTS

	Large Equipment	
1	Table (to be constructed in shop). Overall size of top 3 feet x 6 feet. Overall height 30¾ inches. Constructed of pressed steel legs, top of 36 bd. ft. of 1¾-inch plain sawed white oak with glued joint..	$15.80
5	Stools, 14-inch seat, height 18 inches	4.25
1	Electricians' booth. 53 bd. ft. ¾-inch pine	.15
	33 bd. ft. 2 x 4 pine	.18
	Small Equipment—Hand Tools	
1	Hacksaw frame, pistol grip, adjustable 8 inches to 12 inches	3.25
1	Hickey, pipe bending, malleable iron (½ inch pipe size)	1.75
5 Pairs	Pliers, side cutting, 6 inches	per pr. .63
2 Pairs	Pliers, flat nose, 6 inches	per pr. .63
2	Screw drivers, small blade, 3 inches, composition handle	.65
2	Screw drivers, small blade, 5 inches, composition handle	.80
1	Screw driver, square shaft, 8 inches, composition handle	1.40
1 Pair	Soldering coppers, ½ lb.	.31
1 Pair	Soldering coppers, 1 lb.	.39

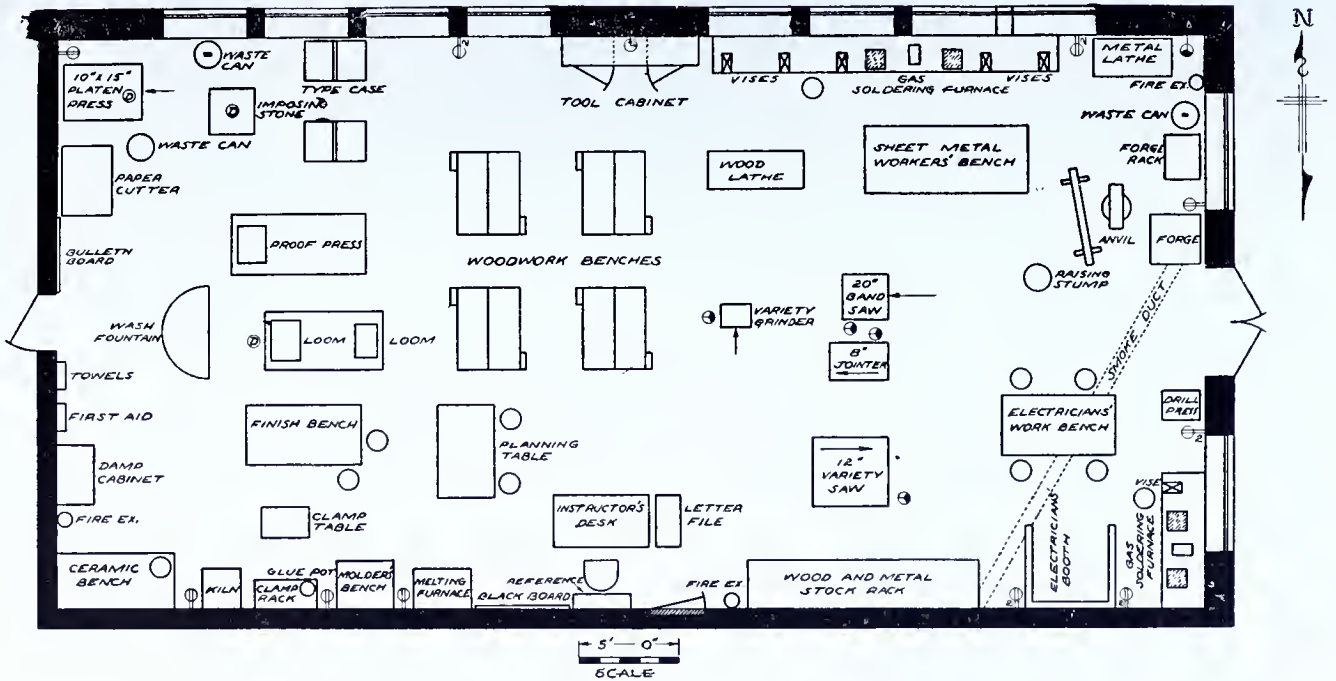
Quantity	*Name and Description*	*Approximate Unit Price*
1	Stock and die set, interchangeable threads, $\frac{1}{4}$-inch to 1-inch pipe	$9.00
1	Vise, compination pipe and machinists', $4\frac{1}{4}$ inches	22.00
2	Rules, pull-push, $\frac{5}{8}$-inch wide, flexible steel, 6 feet length	.50
3	Hammers, 13 oz., curved claw	1.00
1	Brace, ratchet type, alligator jaw, 8-inch swing	1.92
1	Reamer, pipe burring, $\frac{1}{2}$ inch	.30
3	Scratch awls, $3\frac{1}{2}$-inch blade, $\frac{1}{4}$-inch dia.	.45
3	Sloyd knives, $2\frac{5}{8}$-inch blade	.35

Small Equipment Miscellaneous

1	Tungar rectifier, 60 cycle, 115/230 volts A.C., 6 ampere, 6-12 volts D.C.	32.00
3	Transformers, 110-120 V., 50-130 cycles, 10 V Sec.	.64
1	Storage battery, 13 plates, 6 volts, 9 inches x 7 inches x $9\frac{3}{8}$ inches	18.00
1	Pocket ammeter, range 40 amperes A.C.	.81
1	Voltmeter, range 0-50 volts A.C.	.81
1	Voltmeter, range 0-10 volts D.C.	.81
2	Motors, St. Louis, 6.5 inches x 4 inches, 6 inches permanent mag.	3.50
2	Electromagnet attachment for use with St. Louis motor	1.00
100	Conduit and cable clamps, $\frac{1}{2}$ inch	5.10
6	Door bells, $2\frac{1}{2}$-inch bell, double coil	.37
6	Buzzers, double coil	.35
1 Doz.	Push buttons, $1\frac{7}{8}$ inches, brass	.17
10	Light bulbs, 15 watt, clear, 10 volts	.12
100	BX connectors, $\frac{3}{8}$ inch	3.35
2 50-ft. Rolls	BX cable, 14 gauge, 2 wire	1.60
2 Cartons	Receptacles, porcelain, dia. $2\frac{7}{8}$ inches, height, 1 21/32 inches	2.64
2 Cartons 10 Each	Switches, porcelain triple pole with metal cover, 10 A. 125 V., dia. of base 2-11/16 inches, height over cover 1-29/32 inches, height over handles $2\frac{3}{8}$ inches	3.12

ELECTRICITY—5 STUDENTS

5	Entrance cutout switches, fuses at top, double pole main line 30 amp., 110 V. fused	6.32 per carton of 25
2 Cartons 10 Each	Porcelain sub-bases, for devised with max. dia. 2 5/16 inches and min. $1\frac{7}{8}$ inches. Screw spacings $\frac{3}{4}$ inch to $1\frac{3}{8}$ inches	.85
10	Outlet boxes, octagon, dia. $3\frac{1}{4}$ inches, depth $1\frac{1}{2}$ inches	.05
10	Outlet box covers $3\frac{1}{4}$ inches	.03
3	Cutout switch boxes, double pole 30 A., 110 V., $5\frac{1}{2}$ inches x $3\frac{1}{2}$ inches	.35
5 Doz.	Cleats, porcelain, 2 wire	.27
5 Doz.	Split knobs porcelain std.	.17
100	Conduit locknuts $\frac{1}{2}$ inch	.95
100	Conduit bushings $\frac{1}{2}$ inch	1.65
100 Ft.	Conduit $\frac{1}{2}$ inch, wt. 85.2 lb./100 ft.	8.50
$\frac{1}{2}$ Doz.	Soldering copper handles, assorted	.60



SUGGESTED FLOOR PLAN FOR A SENIOR HIGH SCHOOL GENERAL INDUSTRIAL ARTS SHOP
30'—0" X 60'—0"

SHOP TO ACCOMMODATE 30 STUDENTS AS FOLLOWS:

CERAMICS—2 PRINTING—5 ELECTRICITY—5 WOOD—8 TEXTILES—2 METAL—8

SUGGESTED EQUIPMENT SPECIFICATIONS FOR THIS SHOP BEGIN ON PAGE

V. CONCLUSION

This bulletin presents a statement of the philosophy of industrial arts education in which its place in the educational system is indicated.

Rather full suggestions are made concerning the content of industrial arts illustrated through the more common media of expression. Less common but desirable curriculum areas are discussed. Content, method, and floor plans and equipment being closely interrelated an attempt has been made to present a consistent approach throughout. This is likewise true of the section on supervision and administration. The contributors to this bulletin have been free to express what they believe to be best and most expeditious practice for the present and immediate future.

The attempt throughout the bulletin has been to present a point of view and suggested practices in general education which will be increasingly attractive and stimulating to boys and girls in an industrial age.

VI. BIBLIOGRAPHY

ALBERTY, HAROLD. "Development of Core Curriculums." *Educational Research Bulletin.* 17:8:222-231. November 16, 1938.

Alcoa Aluminum and Its Alloys. The Aluminum Company of America, Pittsburgh, Pa. 1937.

BODE, BOYD H. *Democracy as a Way of Life.* New York: The Macmillan Co. 1937.

Building America. Vol. 2, No. 5, pp. 5. New York, N. Y.: Society for Curriculum Study, Inc. 1937.

CARLSEN, F. A. "Pupil Foreman Type of Organization as a Teaching Device in the General Shop." *Industrial Education Magazine.* 1934. pp. 64. Manual Arts Press, Peoria, Ill.

DEWEY, JOHN. "Education and Social Change." *Social Frontier.* Vol. 3, pp. 238. May, 1937.

ERICSON, E. E. *Teaching Problems in Industrial Arts.* Peoria: The Manual Arts Press. 1930. pp. 433.

FAUST, J. FRANK. "What the P. S. E. A. Study Reveals." *Pennsylvania School Journal.* 87:3, pp. 68 November, 1938

Fortune. April, 1936. pp. 136.

FRIESE, JOHN F. *Course-Making in Industrial Education.* State College, Pa. Published by the author.

FRIESE, JOHN F. *Exploring the Manual Arts.* New York: D. Appleton-Century Company. 1926. pp. 412.

GRIM, PAUL R. "Techniques for the Measurement of Attitudes in the Social Studies." *Educational Research Bulletin.* 15:95-104. April, 1936.

HANKAMMER, O. A. "The Derivation of Drawing Content." Western Arts Association Bulletin. pp. 153, Vol. XVII, No. 6. December, 1933. H. E. Wood, Secretary. Indianapolis, Ind.

HAUENSTEIN, E. A. Western Arts Association Bulletin, Vol. XVII, No. 6. December, 1933. H. E. Wood, Secretary. Indianapolis, Ind.

HOBBS, D. B. *Aluminum.* Bruce Publishing Company, Milwaukee, Wis. 1938. *Design for Piercing, Chasing, and Etching.* Wm. Dixon, Inc., Newark, N. J. 1937.

HOBBS, D. B. *Manual for Metal Artists.* Wm. Dixon, Inc., Newark, N. J. 1937.

HUGHES, WAYNE P. "Teaching Aids." *Industrial Arts and Vocational Education.* 26:9:274:276. September, 1937.

JUDD, CHARLES H. *Education as Cultivation of the Higher Metal Processes.* The Macmillan Co. 1936. Chapter II.

KOOS, LEONARD V., and KEFAUVER, GRAYSON. Guidance in Secondary Schools. p. 1. The Macmillan Company, New York. 1932.

LEE, J. M. "Evaluation by the Modern Secondary School Teacher." *California Journal of Education.* 11:278-31. May, 1936.

LINDQUIST, E. F. "Changing Values in Educational Measurement." *Educational Record.* 17:64-81. October, 1936.

MAGILL, W. H. *The Determination of the Graphic Forms and the Frequencies of the Forms Employed in the Current Reading Matter of the Non-Specialist.* Published by W. H. Magill, University of Pennsylvania, Philadelphia, Pa.

National Education Association. *The Unique Function of Education in American Democracy.* Washington, D. C. 1937.

Newkirk, L. V., and Stoddard, G. D. *The General Shop.* Peoria: The Manual Arts Press. 1929. pp. 190.

Printing Education. Vol. VII, No. 5. May, 1931.

Progressive Education Association. *Application of Principles.* Bulletin No. 5. December, 1936.

Progressive Education Association. *Anecdotal Records.* Bulletin No. 1. September, 1935. The Ohio State University, Columbus, Ohio.

Progressive Education Association. *Interpretation of Data.* Bulletin No. 3. October, 1935.

Progressive Education Association. *Measurement of Interests in the Arts.* (Genevieve L. Coy.) 1937.

Progressive Education Association. *Science in General Education.* New York: D. Appleton-Century Co. 1938.

Progressive Education Association. Social Sensitivity. p. 1. Bulletin No. 6. Ohio State University, Columbus, Ohio. December, 1936.

Public Affairs Committee. *Youth in the World of Today.* 8 W. 40th Street. New York. pp. 3. The number of young people out of work in 1936 for the country as a whole was estimated at 4,700,000. This means that over a third of all the unemployed in the country are between sixteen and twenty-four years of age.

Salomon (Lectures of Otto Salomon). *The Theory of Educational Sloyd.* (Second ed.) Boston: Silver, Burdett and Co. 1896. 150 pp.

Smith, Robert E. "Teaching Methods Which Recall and Higher Mental Processes." *Industrial Arts and Vocational Education.* Vol. 27, No. 5. May, 1938. pp. 187.

Smith, Robert E. "Teaching Methods Which Increase Industrial Arts Achievements." *Industrial Arts and Vocational Education.* 27:5:185-188. May, 1938.

Struck, F. T. *Methods in Industrial Education.* New York: John Wiley and Sons, Inc. 1929. pp. 214.

Struck, F. T. *Creative Teaching.* New York: John Wiley and Sons, Inc. 1938. pp. 623.

Studebaker, J. W. "Education for Democracy." *The Nation's Schools.* Vol. 17, No. 3. pp. 23-24. March, 1936.

Tyler, R. W. "Evaluation—A Challenge to Progressive Education." *Progressive Education Magazine.* 8:552-557. December, 1935.

Tyler, R. W. *Constructing Achievement Tests.* Columbus: The Ohio State University. 1934. 102 pp.

Tyler, R. W. "Defining and Measuring Objectives of Progressive Education." *Educational Research Bulletin.* 15: No. 3. pp. 67-72. March 18, 1936.

Tyler, R. W. "Measuring the Ability to Infer." *Educational Research Bulletin.* 9:475-481. November 19, 1930.

United States Department of the Interior. *Industrial Arts: Its Interpretation in American Schools.* pp. 64. Bulletin 1937, No. 34.

Vaughn, S. J., and Mays, A. B. *Content and Methods of the Industrial Arts.* New York: D. Appleton-Century Company. 1924. pp. 397.

Warner, William E. *Policies in Industrial Arts Education.* Chapter V. Columbus: The Ohio State University Press. 1928.

WOIDIN, V. F. "Research Needed in Interest Evaluation." *Educational Research Bulletin.* 16167-71. March, 1937.

WRIGHTSTONE, J. W. "Achievement in Conventional and Progressive Schools." *Progressive Education Magazine.* 13:389-395. May, 1936.

WRIGHTSTONE, J. W. "New Tests for New Needs." *Educational Method.* 15:407-11. May, 1936.

WRIGHTSTONE, J. W. *Appraisal of New Practices in Selected Public Schools.* Bureau of Publications, Teachers College, Columbia University. 1935. 117 pp.

WRIGHTSTONE, J. W. "Appraisal of Newer Elementary School Practices." New York: Bureau of Publications, Teachers College, Columbia University. 1938. 221 pp.